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CHILD DEVELOPMENT

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THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT, INC.

ANNOUNCEMENT

The Society for Research in Child Development, Inc., will meet on Tuesday and Wednesday, February 20 and 21, 1951, in Detroit, Michigan. The Merrill-Palmer School has graciously consented to be host to the Society for this meeting. We are planning in the coming years to hold our annual meeting prior to the meetings of organizations of particular interest to our members. In 1951 our meeting will precede those of the American Orthopsychiatric Association.

Also, the Society will cooperate with the section on Anthropology of the AAAS, at its meetings in Cleveland, December 26 to 30, 1950.

For further details, write the Secretary of the Society,

Dr. Charlotte Del Solar
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ANNOUNCEMENT OF

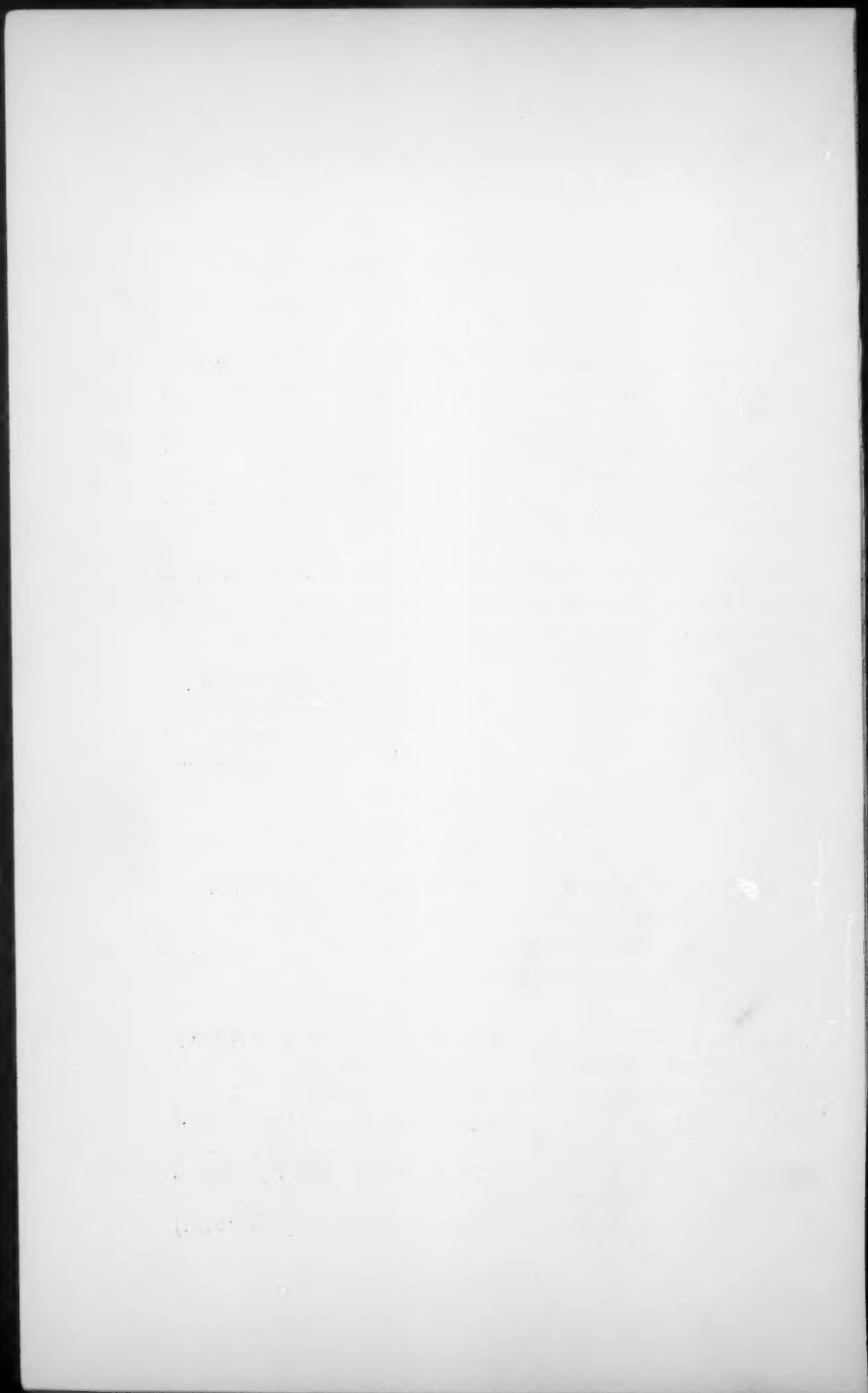
*Joint Session in Cooperation with the Section of Anthropology of
The American Association for the Advancement of Science*

THURSDAY MORNING, DECEMBER 28

9:30 a.m.; Mather Room, Hotel Allerton

Wayne Dennis, *Presiding*

1. Reynolds, E. L. Growth and Body Build: Problems Involved in Studying the Consistency of Body Type in Children.
2. Angel, J. L. Mixture, Flexibility, and Culture Growth.
3. McClelland, D. C. The Use of Imaginative Behavior for Cross-Cultural Comparisons of Children.
4. Barker, R. G., L. S. Barker, and H. F. Wright. The Psychological Ecology of Midwest.
5. Mead, M. Mother and Child as an Intercommunicating System. (Film)



A CRITIQUE ON THE ARTICLES BY MARGARET RIBBLE¹

SAMUEL R. PINNEAU
University of California

I. INTRODUCTION

Since the publication of Margaret Ribble's articles, *The Significance of Infantile Sucking for the Psychic Development of the Individual* (62) in 1939 and *Disorganizing Factors of Infant Personality* (63) in 1941, her work has received considerable recognition. Tomkins (78) of Harvard reprinted the above mentioned articles in his *Contemporary Psychopathology* in 1943. Hunt (42) of Brown University included in his book *Personality and the Behavior Disorders* in 1944 a new article by this author entitled *Infantile Experiences in Relation to Personality Development*. The growing attention and acceptance of her work, as shown in the increasing number of references to these articles by other writers, appears now to call for a critical evaluation.

This paper attempts such an evaluation by considering the points Ribble gives in support of her major premise—the premise that infantile experience is of great importance in directing the development of the infant's personality because of instability and inadequate organization of primary body functions (65 p. 630, 635, 647). She maintains that the infant responds directly and immediately to the emotional tone of his environment and hence that there must be a long period of "psychological mothering" for normal physiological and psychological development (65 p. 633, 638, 647). Purported inadequate and unstable physiological functions constitute, by and large, the basis for her conclusions (63, 64, 65).

II. PHYSIOLOGICAL EVIDENCE

The Status of Circulation

Ribble contends that there is an inadequate and unstable distribution of the blood stream in the child until about the *third* month on the basis that the fetal channels tend to remain open and the postnatal functions of the heart remain incomplete (65 p. 628). She maintains that muscular tension in the infant, prior to the closure of these channels, is of adaptive value in maintaining more nearly adequate circulation (65 p. 629). No evidence is presented to substantiate these contentions. The *available* evidence ap-

¹ The writer gratefully acknowledges his indebtedness to Professor Harold E. Jones for valuable criticisms and suggestions in the writing of this article. He is also obligated to Mary C. Jones, D. H. Copp and Ruth A. Pinneau for their criticisms and assistance. This paper was originally presented at a seminar conducted by H. E. Jones, Else Frenkel-Brunswick, and Mary C. Jones.

pears not merely to refute this position but indicates a remarkable stability in the infant's circulation, and that the heart assumes its adultlike function within a short time after birth. On the subject of closure of the fetal channels, Ribble evidently refers to the obliteration of the ductus arteriosus, the foramen ovale, and the ductus venosus, since others of major importance are closed by tying of the umbilical cord.

The ductus arteriosus: Evidence that the ductus arteriosus closes functionally within the first few minutes after birth, probably within the first five, is indicated by the following:

1. Kennedy and Clark (44), working with guinea pigs, have shown that the increased oxygenation of the blood at birth causes the ductus arteriosus to close by sphincterlike contractions. The histological work of Hayek (80) confirms these findings. The former authors have demonstrated that the contraction is not a neuromuscular reflex, since it still takes place in the absence of all innervations (45).

2. Barclay, Barcroft and others (4, 5) have shown by X-ray cinematography that the ductus in the lamb closes within about five minutes after delivery. They also have shown (6) that only a few minutes are required for the newborn organism to transform the oxygen saturation of its arterial blood from 50 per cent or less to 75 or 80 per cent, a concentration which is not too infrequently found in people living at high altitudes. Ninety per cent oxygen saturation is reached within a few hours.

3. Smith and Kaplan (72) found on measurement of oxygen concentration of the arterial blood of 31 newborn infants, that for some it was in the adult range within one half hour, for all but two it had risen above 90 per cent saturation in two hours, and for these it was above 90 per cent by three hours. In order for the oxygen concentration of the blood to be this high, the ductus must be functionally closed, otherwise, blood by-passing the lungs would have considerably lowered the oxygen saturation (31). According to Arey (1) the ductus is structurally impervious by a post-partum age of one month.

The foramen ovale: The foramen ovale is functionally closed by the septum primum being held in apposition with it by a relatively greater left ventricular blood pressure. The foramen ovale closes functionally within the first few hours after birth as the following studies indicate:

1. The findings noted above (72) that the oxygen saturation of the blood exceeds 90 per cent in the first three postnatal hours in normal infants indicates that closure must have occurred, since otherwise blood by-passing the lungs would have resulted in a lower oxygen saturation (31).

2. Christie (13) found that only 25 per cent of the infants coming to autopsy at eight weeks failed to show complete closure of the foramen ovale. This indicates that in the majority of cases the septum primum must have been in anatomical apposition with the foramen ovale for a considerable length of time in order for fusion to have occurred. In connection

with this finding it should be mentioned that in at least 20 per cent of all individuals complete closure is never achieved (1).

3. As maintained by Scammon (67) the left ventricular blood pressure becomes greater than that of the right almost immediately after birth, thus forcing closure of the foramen ovale. The following material substantiates this contention:

a. The blood pressure of the venous return, relative to the arterial, is lessened after birth. This is because the great amount of blood, which formerly returned by the umbilical vein via the hypogastric arteries, must now circulate through the arterioles, capillaries and venules, and return by the inferior vena cavae. Also tending to increase this relative difference is the increased arteriolar tone after birth.

b. With closure of the ductus arteriosus, the left ventricle receives a larger quantity of the return blood and hence its blood pressure is raised (31). This and the preceding factor work together to create a relatively large difference in blood pressure between the two ventricles (9).

c. The two ventricles weigh approximately the same at birth; however, at the end of two months, the left is almost twice the weight of the right (54). This muscular growth indicates the relatively greater amount of work done by the left ventricle (31).

d. Hamilton and collaborators (31), working with newborn animals, have shown that the right ventricular systolic pressure is slightly higher before respiration, but that after respiration the left is 6 to 12 mm. higher, and at two days, 9 to 27 mm. higher.

The ductus venosus: This channel acts as a shunt through the liver for the oxygenated blood of the fetus. It is functionally occluded by two weeks (56), and anatomically by eight weeks (67). It serves no known function in the infant and closure does not appear to be essential for normal development (73).

The heart musculature: This organ is more than adequate in its ability to meet the pressure demands for distribution to the body at the time of birth. This is shown by the following empirical findings:

1. Upon birth the heart no longer has to pump blood through the distal parts of the fetal circulation. Smith points out that approximately 13 per cent of the blood is left in the placental vessels even after their contraction. Thus after birth the infant must pump only "87 per cent of its former load through about 75 per cent of its former vascular bed" (73 p. 76).² This factor would considerably reduce the work of the heart if it were not for the increased resistance of the infant's tissues due to the increased tone after birth; however, the total work done by the heart is less

² Quotations from Smith, Clement A., *The physiology of the newborn infant* (1st Ed.), 1945. By permission of Charles C. Thomas, Publisher.

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after birth as is shown by the relative decline of heart size to body size (31). (The heart weight doubles in the first year; the body weight triples (73)).

2. From the fourth to eighth prenatal lunar months the heart rate declines, and then accelerates until birth (73). Then the heart rate slows (79), a drop in pulse rate of as much as 50 beats per minute within an hour or more after birth having been reported (3, 24). This appears to indicate a drop in output of the heart per unit of time and thus indicates a reduction in work (9).

3. Haselhorst (32) has found an immediate rise of seven mm. in blood pressure upon birth. This indicates the adequacy of the heart in meeting postnatal blood pressure requirements. Furthermore the blood pressure shows a consistent rise as neonatal age advances. By ten days the pressure is between 95 and 100 mm. of Hg., definitely within the range for normal adults (9, 87).

As a conclusion to this evidence regarding the circulatory system of the infant at birth, I present a statement by Smith: "Although the time varies, only about three hours (and sometimes much less) seem to be required for transforming a circulation which functions like a fetal circulation to one which, whatever be the anatomical state of its passages, functions like an adult circulation" (73 p. 70).

All the conclusions to which we are led by the above findings are contrary to the contentions of Ribble:

1. Rather than being a matter of the "first months," *functional* closure of the fetal channels is a matter of the first hours of postnatal life.
2. Rather than passing through a period of instability and inadequacy in meeting the neonatal needs, the heart is seen to assume its postnatal function in the first day.
3. The blood, rather than showing an unstable and inadequate distribution to the organs as maintained by Ribble, is forced through any pervious passages by a steadily increasing blood pressure.

From the preceding evidence it would appear that in the normal infant the circulatory system is fully adequate to meet the demands placed upon it; hence in this regard, we find no support for Ribble's thesis that in early infancy there is a tendency towards functional disorganization.

The Infant's Oxygen Supply

According to Ribble, another source of instability and inadequacy is the infant's oxygen supply. She says:

One of the most important findings has been that the breathing of the neonate is precarious not only during the first days of life but up to the time that regular vocalization begins which is usually around the third month. Crying during this period appears in all probability to be a form of emergency reaction stimulated by partial suffocation (65 p. 635).³

Several times in her article she calls attention to the fetal and immediate postnatal oxygen condition, so I shall begin here in my consideration of her evidence. She states:

We have definite chemical evidence from the study of prenatal blood chemistry that a low margin of oxygen is present in the general circulation of the fetus (Haselhorst and Stromberger 1930). This physiological anoxemia makes the birth process dangerous . . . The process of birth must further reduce the oxygen content of the infant's blood . . . (65 p. 636).³

Later studies give a different picture of the infant's oxygen supply. Haselhorst and Stromberger (33) measured oxygen concentration in blood samples of the cord in Cesarean operations performed before and after labor. For the pre-labor Cesareans they obtained averages of only 3.5 and 0.9 volumes per cent in the umbilical vein and arteries, respectively. But in the Cesareans performed after several hours of labor they found that the oxygen values were 12.0 and 2.8 volumes per cent for the veins and arteries. Thus we see that during labor the oxygen content of the arterial blood has increased 3.4 times and that of the venous blood 3.1 times. This finding is confirmed by the investigations of Windle and collaborators (86). Thus birth does not appear, from the standpoint of oxygen supply, to be the dangerous and traumatic experience which Ribble would have us to believe.

Not only are newborn infants less sensitive to oxygen deprivation than Ribble contends, but they are better able to withstand oxygen want than the adult. This is clearly shown by the fact that the adult who fails to breathe for seven or eight minutes does not breathe again, but infants who have not breathed for more than 10 minutes after delivery may not only be revived, but may be perfectly normal (73). In fact Smith (72) cites a case of a newborn infant who had not breathed for 14 minutes after birth, yet apparently developed normally. He feels that a period of anoxia of 15 minutes is within the extreme limit (73). Further substantiation of this is found in studies on the young of other species: Studies by Selle and Witten (70) on young rats, by Himwich and colleagues (37) on young dogs, and by Borgard and Hoffman (11) and Reiss and Hauroitz (61) on young mice.

From a review of the measurements of Brinkman and Jonxis of oxygen arterial content, Smith (73 p. 37) concludes that the infant's life may proceed normally and without symptoms at oxygen saturations as low as 77 per cent. Wilson and colleagues' (84) recent work on anaerobic sources of energy in the infant confirms this. They found that acidosis exists in the infant due to a carbon dioxide deficit resulting from a metabolism involving less oxygen per unit of energy than in the adult. Thus less than the

³ Quotations from Ribble, Margaret. Infantile experiences in relation to personality development. In J. McV. Hunt, (Ed.), *Personality and the behavior disorders*. II. 1944. Permission granted by the Ronald Press Co. to quote this and all subsequent excerpts from this article.

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usual amount of CO_2 is being formed and a low concentration of CO_2 in the body fluid is maintained by what appears "adultomorphically" to be deficient pulmonary respiration and a low rate of CO_2 excretion.

Despite the ability of the infant to withstand anoxic insult, we shall see that normally the oxygen saturation of the infant's blood is not only above that found in the fetus, but is within the adult range in a matter of about three hours after birth. This is in direct contradiction to Ribble's contention that the infant's breathing is precarious until about the third month and that his breathing mechanisms are inadequate to meet his postnatal needs.

1. After birth a larger volume of oxygenated blood enters the left ventricle because of the closure of the ductus arteriosus and the foramen ovale (31). This results in a greater supply of oxygenated blood to the external and internal carotid arteries, and also to the vertebral and basilar arteries as the blood of the aorta is no longer mixed with unoxygenated blood coming through the ductus arteriosus.

2. In the fetus, oxygenated blood coming from the umbilical vein may have an oxygen saturation of 60-80 per cent of its capacity (73 p. 64). This concentration is lowered by mixture with the deoxygenated blood of the portal vein, the inferior vena cava, and by whatever admixture of blood there is of the superior and inferior vena cavae. The result is a lower oxygen saturation of the blood reaching the heart, hence far below that found in the normal infant two or three hours after birth (72).

3. Normally in the newborn animals, Schmitt (69) has found that within the first minute after breathing begins, the umbilical cord begins to contract as a result of the increased oxygen. This he verified for infants by oxygen perfusion experiments on the umbilical vessels.

4. Regarding the large volume of blood in the placenta, and its oxygenation, Smith states: "A variable and not inconsequential share of this is in the cord vessels themselves and thus not actually in position for placental exchange at any one moment, but the total amount is so much greater than that later occupying the lungs as to suggest the qualitative inferiority of placental as compared to pulmonary respiration. . ." (73 p. 75).

5. Almost immediately after birth the heart rate declines (73) indicating that the demand for rapid flow of oxygenated blood to the infant's organs is lessened. As the infant's demands for oxygen increase, this can only mean that the blood is so much better oxygenated that it can meet these greater needs and still flow at a slower rate.

6. At birth, a phase of red blood cell and hemoglobin augmentation is coming to a close, and usually, though not always, the number of RBC's is above that of the adult (1). The number of erythrocytes declines after the first day of life, reaching the lowest level at six to nine weeks (73). "A universal finding is that the number of nucleated cells begins declining immediately after birth . . ." (73 p. 109), and contrary to some opinions, the RBC fragility after birth decreases rather than increases (81). It may

be justifiably inferred that the oxygen need of the fetus has led to this increased RBC count, and that at birth the fall to the adult level and decrease in immature RBC's is the result of a better oxygen supply (73). In this connection it should be mentioned that in the adult and in animals, lowering of the atmospheric oxygen pressure artificially, or by moving to a higher altitude results in increased RBC's and the number of immature cells in the blood (6, 9). Return to normal atmospheric pressure results in a blood condition comparable to that found in the neonate (73).

From the above evidence we can conclude the following: One, normally the birth process augments the oxygen supply of the fetus; two, newborn infants appear to reach the adult level of oxygenation in a few hours; three, they appear capable of enduring an extraordinary degree of asphyxia.

We now give consideration to the adequacy of the infant's breathing mechanisms. Although we have seen that the prenatal oxygen demand is much lower than that after birth, the evidence shows that the lungs are more than adequately developed to supply the oxygen needs of the infant. It is generally recognized that complete expansion of the lungs does not occur during the first weeks of life, but Smith and Kaplan have shown through "simultaneous roentgenograms and measurement of arterial blood oxygen, that adequate pulmonary function does not necessitate complete expansion of all portions . . . , so that there is obviously a considerable margin of safety within which the partially expanded lung meets the body's demands upon it" (73 p. 47-48).

Ribble reports a finding by Snyder and Rosenfeld (1938) to the effect that in neither the fetus nor the newborn is respiration regulated primarily by the percentage of carbon dioxide in the blood (63 p. 636). This conclusion is not given in that article and the information therein does not warrant such an interpretation. However these authors do say, "It is evident that sensitivity to excess carbon dioxide is present in animals born throughout the period of prematurity, and first appears at the same times as anoxic stimulation, namely, at the beginning of viability" (66 p. 247). They further state: "The transition from the intra-uterine to adult type of respiratory response occurred abruptly at birth instead of developing gradually during post-natal life" (66 p. 249).

It appears that inhibition is not present in the respiratory apparatus of the fetus, but that the gaseous exchange is such that only infrequently are there variations which call it into action.⁴ The controversy here centers around the relative importance of the medullary centre versus the aortic and carotid bodies, and whether or not the latter are active at birth. The use of lobeline by Wilson, Torrey and Johnson (85) to stimulate these latter bodies in newborn infants is evidence confirming their activity.

Several investigators have found that the respiratory center is inactivated by extreme anoxia. According to Smith, "It seems probable that the fetal and newborn medullary center is in, or at least bordering upon, a state of

⁴ Cf. pp. 207-208 regarding research of Wilson and colleagues (84).

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depression at normal delivery and that these more recently studied mechanisms, (the carotid and aortic bodies) are in control of breathing" (73 p. 35). The relative importance of these mechanisms has been assayed by Schmidt and Comroe (68) who previously held, and strongly supported, the view that the carotid and aortic bodies are not active under normal conditions, but who now present the following statement as being in accord with the existing information: "Different chemoreceptors have widely different sensitiveness to the stimuli furnished by the blood; a small proportion are so sensitive that they are continually active under any circumstances compatible with life, but the majority only become active when the stimulus level is increased" (68 p. 143).

Schmidt and Comroe conclude that these chemoreceptors are more reactive to anoxemia in sensitivity, speed, intensity, and durability than the medullary body. On the other hand, they conclude that the hyperpnea of increased carbon dioxide begins primarily as a central affair and depends on reflex stimulation to a great extent, only when the center is depressed, as at high carbon dioxide or acid concentrations. Their article also shows that a change of pH of 0.1 in the blood is sufficient to stimulate the carotid body (68). The range of pH compatible with life in the adult is probably not more or less than 6.8-7.8 (9). The pH of the blood of the one-week-old infant is well within this range and is rather narrowly regulated around 7.4 (39, 48). Thus even if the medullary center is in, or bordering on a state of depression at birth as hypothesized by Smith, any excess of carbon dioxide sufficient to raise the pH of the blood by 0.1 is adequately met by the infant's carotid and aortic mechanisms.

The above evidence and conclusions are in direct contradiction to Ribble's argument that the infant's breathing mechanisms are so immature that they are inadequate in meeting his oxygen needs; however, we have yet to deal with other factors which she gives in support of this contention.

Ribble has described the breathing of the infant as rapid, shallow, and irregular (65 p. 629). These infantile patterns of breathing, she implies, are inadequate in meeting the infant's oxygen needs. This implication is refuted by the work of Deming and Washburn (18) in which they found that the patterns of respiration in normal resting infants are "regular," "cogwheel," and "periodic." They found that no single rhythm was consistently exhibited by an individual infant and that none of these types was more efficient than the others as indicated by minute volume. Raiha and Salmi (60) were successful in showing that periodicity can result from the excess hemoglobin often present in early prematurity. Wilson and colleagues' (84) recent studies on anaerobic sources of energy further negate the importance of Ribble's contention and indicate that these irregularities are probably produced by low carbon dioxide concentration in the blood.⁵

As previously mentioned, Ribble believes that crying during the first

⁵ Cf. pp. 207-208 regarding research of Wilson and colleagues (84).

three months is a form of emergency reaction stimulated by partial suffocation. Inasmuch as we have seen that the normal infant's respiration is more than adequate, this belief has no support. Undoubtedly in the infant, as in the adult, emotional reactions result in greater oxygen consumption and hence in increased respiration.

The above evidence on respiration leads us to conclusions which are contrary to Ribble's contentions:

1. Rather than reducing the oxygen supply, the birth process augments it.
2. Rather than being inadequate in the neonate, the oxygen supply is more than sufficient to meet his demands.
3. Respiration is regulated by the saturation of both oxygen and carbon dioxide in the newborn, though the carbon dioxide level is so low as to rarely excite the center to any great extent.
4. Irregularities in the infant's breathing are characteristically not a sign of inadequate functioning of the infant's respiratory mechanisms.
5. Breathing is not precarious for the first three postnatal months. The evidence indicates that respiration is stabilized on an adultlike level in the first days of postnatal life.
6. There appears to be no basis for the speculation that crying during the months subsequent to birth is an emergency reaction stimulated by partial suffocation.

Thus we have seen that the physiological evidence on the status of respiration in the fetus and infant in no way supports Ribble's contention that handling is necessary in the majority of babies to help them breathe adequately, or her major thesis that the infant is continually bordering on functional disorganization.

Gastrointestinal Status of the Infant

Ribble supports her thesis of instability and inadequacy in the infant, with an appraisal of the digestive functions as follows: "... the gastrointestinal functions are easily disturbed as is shown by the frequency of regurgitation, hiccoughs, and diarrhea" (65 p. 630).⁶ In a later paragraph she says:

Those who are not held in the arms sufficiently, particularly if they are bottle fed babies, also develop gastro-intestinal disorders. They become air swallowers and frequently develop what is popularly known as colic (65 p. 631).⁶

Here as elsewhere in her article, Ribble appears to disregard alternative hypotheses, consequently neglecting consideration of many pertinent facts. Attention to some of the other hypotheses will be given here.

⁶ Cf. footnote 3.

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Regarding the causes of diarrhea, Ribble has said nothing, but she implies that it is due to the reaction of bottle-fed babies to a lack of "mothering." Faber et al. (23) and Stevenson (76) from their studies found no significant differences between breast- and bottle-fed babies in the amount of diarrhea present. A not implausible explanation for diarrhea may be that it is frequently due to irritation from the normal bacterial invasion of the germ free intestines of the newborn (50). It is interesting in this respect, that to relieve constipation, a commercial preparation of acidophilus bacilli is frequently given to increase the intestinal flora (74). (In the adult about one-half of the daily fecal mass is composed of microorganisms (73 p. 180).)

Ribble finds that bottle-fed babies who are not held in the arms sufficiently are air swallowers. This is undoubtedly true as the evidence indicates that all infants are air swallowers:

1. When films are taken within five to ten minutes after the infant's birth, they usually show a gastric bubble. If air is not found in the intestines in four to eight hours after delivery, a diagnosis of obstruction is indicated (58).

2. Henderson (34 p. 321) states "When the infant cries during feeding, large amounts of air are swallowed and the stomach may become easily four or five times the size when only a two ounce meal is present."

3. "... the size of the infant's stomach after a meal depends not on the amount of food, but on the amount of air swallowed" (73 p. 169; 34, 77).

4. Paine and Nessa (58) found that air is more or less equally distributed between the small and large intestines throughout the first year of life. After this, air is rarely present except in the colon.

According to Ribble's presentation, air swallowing and the resulting colic and regurgitation is due to a lack of mothering (65 p. 631), a lack of holding the infant in the mother's arms which she apparently equates with a lack of love (65 p. 630, 638, 647). This view is not in accordance with the above facts. Normally, infants appear to be air swallowers. Pathological air swallowing must be defined in respect to such facts as given above. A consideration of the infant's behavior shows that when he is picked up his crying ceases, air swallowing stops, and the air swallowed is frequently expelled, whether or not he is intentionally bubbled. Thus, rather than "mothering" per se, the important factor is apparently to stop the crying and expel the air before feeding is started.

Other factors which may increase air swallowing deserve consideration, e.g., the position of the infant during feeding may be important (83). These questions might be asked: Is more air swallowed in the supine position than in the upright one? With regard to regurgitation, does position make a difference as to whether air or milk is expelled, and as to the ease of such expulsions? Is the "mothered" child bubbled more than the child left to his bed, thus reducing the amount of air present in his stom-

ach? Such questions must be answered before any conclusions may be drawn, let alone those posited by Ribble.

Ribble contends that bottle-fed babies develop more gastro-intestinal disorders. Although this view does not accord with the available facts, if future research supports her opinion, the cause of "such disorders" may lie in the difference in human and cow's milk. Research has shown many differences: Human milk leaves the stomach more rapidly than cow's milk (28, 46). A diet of human milk is less apt to produce rachitic bones than one of cow's milk, although this nutritional deficiency of the latter may be corrected by the administration of extra vitamin D (73). Cow's milk is a poorer source of iron (75), and the vitamin A and vitamin C content is less than that of human milk (73). Cow's milk is more acid than human milk (47, 49). These plus other known differences, e.g., fat composition (36) and retention by the infant (41, 76), chemical composition of casein (53), difference in amount of proteins and their metabolism (76, 82) together with other as yet unanalyzed dissimilarities, indicate that some infants may find difficulty in adjusting to a phylogenetically unnatural milk; however, any nutritional deficiencies in the milk may be met with vitamins and other supplements.

Let the information above should be used as an advocacy of breast feeding, it is noted that the maturational level of the normal infant's gastro-intestinal tract is adequate to digest and assimilate cow's milk and other simple foods. Smith, drawing his conclusion from a vast number of studies, says:

An adequate group of enzymes for all simple foods except starches appears to be available even before premature birth, though pancreatic amylase remains deficient for some months of early infancy. . . . In general, the normal newborn patient has a physical capacity for food which is unlikely to be exceeded by any ordinary dietary program. The enzymes available for digestion have not been found inadequate to deal with any type of food except complex carbohydrates (73 p. 183).

Some studies have shown the effects of bottle feeding to be superior, e.g., that of Faber, Sutton and Sutton (23) which is the best controlled study comparing the effects of human versus cow's milk. They found that the number of infections were much greater in the breast-fed group, were more severe and were accompanied by more complications.

In consequence of the above facts and the apparently uncontrolled variables in Ribble's work, the factors which she mentions definitely cannot be considered as evidence of the sensitivity of the infant's digestive system to a lack of "mothering," or as evidence of difficulties resulting from bottle feeding. Thus her views have been refuted as supportive to her more general thesis of general instability and inadequacy in structural and functional development.

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The Nervous System of the Infant

Ribble makes numerous references to the infant's nervous system, her chief point being that the infant is essentially a precerebrate organism at birth. She informs us that many nerve tracts are unmyelinated and that the brain circulation is not well established (65 p. 628). She states that: "The need for oxygen may become acute because the young infant's breathing mechanisms are not well enough developed to work adequately with the increasing inner demands caused by rapid forebrain development" (65 p. 630),⁷ and that: "The development of the forebrain during the first year of life is a tremendous feat in view of the phylogenetic history of this organ" (65 p. 628).⁷

Regarding myelination, there is sufficient information at present to show that it is not necessary for functioning of the nerves—e.g., some nerves are never myelinated, and the eye begins functioning before myelination of its fibers (9, 14).

Regarding circulation and supply of oxygen to the brain of the normal infant, aforementioned evidence does not support Ribble's view that it is inadequate, but rather that it is *more* than adequate.⁸ The blood pressure shows an immediate rise on birth and is well within the adult range by the tenth day.⁹ Thus the heart has the ability to pump the blood to any needed region. Also of importance is the fact that the circulatory system of the head gets first call on this increased pressure, since the innominate, which is the first major artery to branch off the aorta, immediately gives off the internal carotid to the head. The supply for the basilar artery also benefits from the increased pressure.¹⁰ The blood in these arteries carries to the head the great increase in oxygen found in the newborn. To substantiate her argument, Ribble (65 p. 633) quotes Grinker's assertion that white matter uses less oxygen than gray, and that a reverse relationship exists between the age of the animal and the oxygen consumption of the brain. This assertion is probably based on the relatively greater preponderance of gray matter in the brain of the infant. However, we have already seen that this relationship does not hold for the infant due to the qualitative differences in his metabolism (84) and due to the greater ability of his nervous system to withstand anoxemia.¹¹

In further considering this aspect of the infant's developmental status, Ribble says:

⁷ Cf. footnote 3.

⁸ Cf. pp. 204, 208-209.

⁹ Cf. pp. 205-206.

¹⁰ Cf. pp. 205-206, 208.

¹¹ Cf. pp. 207-208.

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The need for contact with the mother is urgent in order to keep the reflex mechanisms connected with breathing in operation as well as to bring the nervous system into functional activity (65 p. 630).¹²

It seems clear that the nervous system of the infant needs some sort of "stimulus feeding" or rhythmic vibratory movement to facilitate its development (65 p. 632).¹²

The findings of Danzinger and Frank (15)¹³ that there is apparently no developmental impairment of the nervous system, or social or emotional stunting, when there is no "stimulus feeding," is not discussed by Ribble.

Tension in the Newborn

Throughout her article Ribble continually refers to the muscle tonus of the infant in terms of "tension" (65 p. 629). She states that muscle tonus can be used as a measure of the degree of "functional integration" (65 p. 630). There is no support for this statement and, as the following evidence clearly shows, the further conjectures based on it are in error.

Ribble says that "These tensional states have a physiological basis, and to the writer they appear to be concerned with the maintenance of the circulation of oxygen and nutritional substance to the head during the period before the fetal channels are obliterated and the heart has definitely assumed its post-natal function" (65 p. 629),¹² which according to her is about the third month. In the next paragraph she seemingly contradicts this by saying that as tension increases inadequate breathing occurs (65 p. 629). She further states that the cause of these "tensional states" appears to be "cerebral anoxemia" (65 p. 638, 62 p. 13). In the discussion on the circulatory system, it was shown that the fetal channels close functionally within about three hours after birth in the normal infant, and, as an increase in oxygenated blood and an increase in blood pressure is found after birth, any muscular tension present in the normal infant after the first day, does not serve the purpose indicated by Ribble.

Ribble says: "A general state of observable muscular tension existed and readily became exaggerated in about 30 per cent of the 600 newborn babies in my study" (65 p. 629).¹² She mentions a number of ways to lower this

¹² Cf. footnote 3.

¹³ Orlansky summarizes the study of these Viennese psychologists as follows: [They] "compared the development of Albanian children raised under conditions of great physical restraint, with that of Viennese children. . . Until they are a year old, the Albanian children customarily are placed in the darkest corner of the room, often with a cloth over their heads so that no light is visible. These children displayed poor muscular coordination, but once given the opportunity of practice, their performance improved rapidly so that it was clear no permanent retardation has been effected. Their social behavior, as measured by responses to the experimenters in a series of standardized tests, was equal or superior to the norms for Viennese children of the same age" (57 p. 16). (Quotations from this article by permission of the author.)

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tension.¹⁴ All of these either involve some outside source of warmth or means of insulation so that the necessity of the infant maintaining its metabolism at the former level was not required, or they involved imposed stimulation and manipulation leading to movement of specific muscles and/or mass activity with resultant increase in heat production. This leads to the hypothesis that "tension" found in the newborn infant is at least partially a means of maintaining his body temperature inasmuch as his other chemical and physical means of temperature regulation are imperfect (73). (It should be noted that the normal infant's temperature is regulated between 98 and 99 degrees F within about eight hours after birth (73).)

Here the observations of Barcroft (7) are of importance and more in line with the views I have stated than with those of Ribble:

Apart from such specific sensations (as the proprioceptive impulses from the chest after the first breath)¹⁵ the general flood of stimuli from the skin and probably from the muscles and the joints are of first importance, for we must remember that at birth not only is the surface of the fetus exposed to cold and to contact with surrounding objects, but removal from the aqueous environment subjects it to the strains put upon it by its own weight. . . . A fetus with its placental circulation intact, alternately taken out of and replaced in its bath of saline, exhibits muscular tone to the point of shivering when it is taken out of the bath and relaxation when it is replaced (7 p. 120).

It may be concluded from the preceding that "tension" is a normal phenomenon in the newborn. The evidence in no way supports Ribble's speculation that the progress of the integration of external respiration and metabolic needs may be inferred from changes in muscle tone (65 p. 630), nor does it support her major premise that the infant tends toward functional disorganization until well into the second year due to a general physiological instability and inadequacy.

III. PSYCHOLOGICAL EVIDENCE

Sucking in the Newborn

Ribble (62 p. 2) builds her argument for the importance of sucking on the innervation of the tongue by five cranial nerves and the development of its epithelium from the ectodermal germ layer. On this basis she states that

¹⁴ These ways are unsupported in the findings of Sherman and Sherman: "When an infant below four or five days of age is dropped one or two feet it frequently shows no perceptible response. . . . This is also true for so-called 'pleasurable' stimuli, such as stroking or petting, to which many newborn infants show no overt reaction" (71 p. 145). Thus their study also refutes another of Ribble's contentions: "If the body of the newborn infant is not well supported by wrappings or if the child is picked up suddenly or moved about rapidly or violently, it reacts immediately with a startle" (65 p. 632; 63 p. 11). (Cf. footnote 3.)

¹⁵ Parenthetical explanation mine.

it has a close connection with the higher cerebral centers and is the structurally sensitized pathway between the inner and the outer world.

A consideration of the nerve supply shows that four of these five cranial nerves (V, VII, IX, X) are sensory (1, 9). Three of them (VII, IX, X) supply the taste buds, and only one, the lingual branch of the fifth, is involved in reactions to stimuli such as pain, pressure, et cetera. The twelfth is the motor nerve supplying the muscles of the tongue (9). The oral cavity may be the most sensitive region of the newborn, but it is clear that only the lingual is stimulated by sucking per se, and hence the impressiveness supposed to be inferred from the innervation of the tongue by *many* cranial nerves is not substantiated. That the epithelium of the tongue is of ectodermal origin does not in itself put it in a hierarchial position as regards orientation to the outer world. The hair, nails, and enamel of the teeth, are also derivatives of the ectodermal germ layer (1).

Ribble (62) states that the development of the root of the tongue indicates that its first function is the pumping of blood toward the brain and that certain movements of the tongue in premature infants are indicative of this process. Ribble maintains this on the basis that the root of the tongue migrates forward from the first branchial arch to join the body of the tongue. Such a view is not supported by embryological evidence. The muscles of the tongue do not migrate forward; they arise in situ from the mesenchyme of the arches that make up the floor of the mouth (1).

Ribble's position is further shown in the following quotations:

It is to sucking as the tactile nucleus around which primary sensory impressions of sight, hearing, and touch become associated that the writer wishes to call attention. . . (62 p. 1).

The evidence indicates that sucking experience is important for the general well being of the child, for the development of alertness towards factors outside the child's own body, for the age at which speech appears, and for the facility of the speech function (65 p. 637).¹⁶

Perhaps the best evidence against this point of view is the research on fraternal twins by Dennis (19, 21, 55):

They were raised out of the recumbent position only slightly even when in the tub or when feeding. During the first six months we kept a straight face in the babies' presence neither smiling or frowning, and never played with them, petted them, etc. . . . Likewise for the first six months we did not use our voices in any way which might associate their vocalizations with the care of the babies. . . (19 p. 19).¹⁷

These factors were as rigorously controlled during feeding periods as at other times. Yet there was no indication of any retardation in "sensory, intake and perception of another individual" (62 p. 1), or any lack of

¹⁶ Cf. footnote 3.

¹⁷ Cf. footnote 26 for conclusions on this study.

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discrimination or lack of organization of experience in the behavioral development of the infants.

Ribble further states:

The first definite evidence of satisfaction, the disappearance of activity and muscular tension, appears in the newborn after vigorous sucking . . . The sucking itself appears to be pleasurable.¹⁸ From the fact that these phenomena appear during the first days of life it is clear that the newborn infant must derive his first pleasurable orientation to the outside world through the mouth *by way of his own sucking* (65 p. 631).¹⁹

It is apparent that Ribble conceives of sucking as not merely a means to an end, but a drive in its own right. (This conception has received a telling blow by the recent empirical finding of Sears et al. (17),²⁰ and Fredeen (27).) This speculation is based at least partially on her statement that "More than hunger satisfaction appears to be involved, for relief of tension appears even when an insignificant amount of food, as determined in a breast fed baby by weighing before and after nursing, has been ingested" (65 p. 631).¹⁹ Ribble fails to say what she means by "insignificant amount of food." As the stomach of the newborn has not as yet had to deal with food, defining an "insignificant amount" presents a problem. In terms of body weight, the consumption of a cup of milk by an adult is equivalent to an intake of only 0.23 to 0.45 ounces by an infant of two weeks (73). Hence an intake of 0.1 ounce may be significant for the newborn. Before sucking could be accepted as a drive in the infant, other questions must be answered: What, if any, relationship exists between sucking and hunger as experienced by the infant, perhaps as judged by stomach contractions, blood sugar level, et cetera? What factors start the "periodical" sucking of the infant, and is the sucking drive satisfied if there is no food taken?

Regarding the strength of the "sucking drive" at birth, Ribble writes: "In observing several hundred normal infants placed at the breast for the first time, approximately eighty per cent suck at once if they are securely held in comfortable apposition to the breast" (62 p. 2). In her last article, after the first one was accepted so well, she gives us an entirely different picture of the condition. She states: "Fifty per cent of the 600 babies in our study were definitely not 'self-starters' in sucking" (65 p. 628).¹⁹ If in the first part of the study, several hundred referred to more than 200,

¹⁸ Such "adultomorphic" interpretations require cautious acceptance in view of the careful studies on infant emotions by such investigators as Sherman and Sherman (71). Using graduate students in psychology as judges, they found that "In estimating the emotional behavior of infants, people tend to read into it their own attitudes towards the expected reaction. . . . Frequently we ascribe to the child reactions to which he is not at all capable. . . . Most persons judge the emotional behavior of an individual in terms of the stimuli which have produced the reactions" (71 pp. 122-123, 142).

¹⁹ Cf. footnote 3.

²⁰ Cf. p. 219 regarding Sears et al.

as is the usual reference, then using 300 as an estimation of her number of subjects, only 20 per cent of the second sample sucked at once. If we used the minimal number, 200, then only 35 per cent sucked at once. Thus in the subsequent 300-400 infants only 20-35 per cent sucked at once as compared to 80 per cent in the first 200-300. It appears rather hazardous for Ribble to use such discordant findings as support for her hypothesis. Ribble states:

When sucking is not easily established or when it is not sufficiently exercised or prematurely interrupted, significant dissociations take place in general maintenance of reflex tone in the sensory motor integrations of vision, hearing, and grasp, which result in retardation of central nervous control. Dissociated sucking of thumbs or some habitual object which is so much dreaded in the nursery, appears to come about when the infant does not get enough sucking exercise in connection with the taking of nourishment.²¹ It appears to be a defense mechanism against a more serious regressive reaction in which all tactile reflex sensibility may be abandoned and the organism may deteriorate to a purely vegetative type of functioning (62 p. 7-8).

Here again Ribble has failed to consider all phases of the subject. Because she had "observed" these conditions in the same time and space, she assumes a causal relationship. The fact that all reflexes were apparently functioning at an immature developmental level leads to the hypothesis that the maturational level of these infants was generally below the norm for their age.

Ribble maintains that a minimum sucking time of two hours a day is required. Sears et al. (17) have shown that *no sucking time is required*. They studied the effects of three types of feeding on 60 newborn infants. These infants were divided into three groups of 20 each according to type of feeding—breast feeding, bottle feeding, and cup feeding. The results of this study show few significant differences, although the feeding time of the breast-fed group was almost twice as long and although the cup-fed group received no satisfaction of their "sucking drive." The breast-fed group showed a significantly stronger response to the sucking test by the tenth day, a significantly higher number of non-eager feedings during the first three days, and a slightly but insignificantly higher amount of crying and general body activity. No significant difference was found between the groups in spontaneous oral activity. In general "The cup-fed group showed less sign of frustration or unsatisfied oral drive than did the breast-fed group." The conclusions of this study are in agreement with those of Robert C. Fredeen (27) and others (2, 16, 29, 59).

²¹ In their studies, Davis and Havighurst found that "The Negro middle-class children are treated much more permissively than the white middle-class children with respect to feeding and weaning . . . Yet the proportion of Negro middle-class children reported sucking their thumb is almost the same as the proportion of white middle-class children so reported" (16 p. 707).

The preceding evidence and considerations refute the significance of a "favorable sucking experience" as defined and delimited by Ribble and add further to the refutation of her general thesis.

"Mothering" as Related to the Infant's Development

Ribble says that "Complete helplessness is the outstanding psychological characteristic of the newborn" (65 p. 628).²² Regarding the separation of infant and mother for a two week "lying-in" period, she states:

From the observations of the writer, such early experience definitely interrupts the formation of the child's emotional attachment for the mother and the initial sense of security that should replace the chemical union through the placenta. Furthermore, such early experience predisposes these sensitive infants to anxiety²³ (65 p. 631).²²

Such statements demand the child's recognition of the mother and a perception of emotional stimuli and situations. According to Jersild (43), the infant does not seem able to distinguish between individuals and objects until about three months of age. Signs that the child recognizes his mother may appear by three months, but the ability to distinguish between other persons usually comes after this ability to discriminate becomes more evident. "Until the age of five months, smiles in response to the gaze or voice of another person, are likely to appear whether the voice is friendly or angry in tone, or whether the gaze is accompanied by an angry or friendly expression" (43 p. 159).

In consideration of these facts and as Ribble makes the following statement earlier in her article, little credence can be given to her stress on the "significance" of separation of mother and child in the "lying-in" period. She has said that until between the second and third month "the infant is practically a *precerebrate organism*,²⁴ for the forebrain is incomplete. Histologically we know that the cerebrum is incomplete and many of the nerve tracts are unmyelinated . . ." (65 p. 628). If this be true, how can the infant show the discrimination and awareness that is implicit in her previous statements? Orlansky sums up the available information on this subject as follows: "The best observations we have to date indicate that the newborn infant knows neither anxiety nor confidence, fear nor happiness,

²² Cf. footnote 3.

²³ Hendrick's comment appears quite applicable to these speculations of Ribble in the light of the evidence presented in this article: "Thus some analytic portrayals of the actual infant seem far more the projection of analytic theory and adult passions than scientific observation" (35 p. 33). Orlansky also evaluates them: "Such statements reflect only the subjective judgment of their authors, as is evident from the very form in which they are cast, there is as yet no evidence to support or disprove these assertions (and perhaps that is why the emotions are so frequently resorted to in propounding them)" (57 p. 30).

²⁴ Italics mine.

but exists in an affectless and presumably consciousness state" (57 p. 30).

Ribble maintains that there is a "Necessity for a long and uninterrupted period of consistent and skillful 'psychological mothering' by one individual (where the mother herself is not available)"²⁵ (62 p. 10).

Regarding reactions to inadequate mothering, she says:

Young babies who have not been "mothered," or those who have had adequate care and then suddenly lose it, commonly develop one of two general types of reaction.²⁶ They may develop a form of negativistic excitement or a form of regressive quiescence (65 p. 633).²⁷

She discusses the negativistic reaction at greater length and considers it as being the most severe. She says:

This regressive reaction, which may develop acutely in young infants, is strongly similar to, or is perhaps identical with, a chronic disease known as marasmus . . . it affects particularly children in the first year of life, and less than three decades ago, under the name of "debility" or "infantile atrophy," it used to be responsible for nearly half of the infant mortality rate (Holt 1918) . . . The present indications are that this malady was not due primarily to inappropriate feeding or digestive disturbance, nor, as some investigators have thought, to some basic biological defect of circulation. It has instead the nature of a general disorganization of functions and a deterioration of primary body reflexes due in large measure to lack of "mothering" or stimulation (65 p. 634).²⁷

In view of the following material, we cannot agree with this contention. It is immediately noted on examination of her reference to Holt (40) that statistics cited by him show that a mortality rate of only about 15 per cent is the direct result of marasmus. Holt's own statement of approximately 50 per cent is based on uncontrolled observation and subjective estimation. Such statements with no empirical support cannot be accepted as scientific evidence. Furthermore, Ribble fails to give any weight to advancement of pediatrics and medicine in general, with their improvements in diagnostic techniques, differential diagnosis, new skills, and remedial treatments.

²⁵ Such a contention would lead us to expect severe emotional disturbances in such primitive tribes as the Samoans, as Margaret Mead says that their "Children are frequently suckled by other women of the household or of related households and become accustomed to a number of 'mothers' whom they see every day" (52 p. 306); however, she describes them as secure and well adjusted (51).

²⁶ In the study by Dennis on twins (19, 20, 21, 55) practically every one of the admonitions of Ribble regarding "mothering" were carried to the opposite extreme, yet the conclusions reached were as follows:

1. ". . . essentially normal behavioral development can occur in some infants when the first year is spent under conditions of minimal social stimulation."
2. "Fondling is not necessary for the development of interest in and every sign of affection for the adult."
3. "The infant's own activities, even within the simplest environment are sufficient to induce the supplementary learning which the unlearned responses of the infant requires" (55 p. 218).

²⁷ Cf. footnote 3.

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Other evidence indicates that marasmus is probably not a clinical entity but an early devised nomenclature to cover numerous obscure clinical manifestations (88). In contemporary books on nutrition it is included under the subject of "malnutrition" (50). Hislop (38), on noting that adrenal hypofunction is concomitant with marasmus, injected marasmic infants with eucortone. He concluded that until this insufficiency is corrected, recovery is retarded or impossible. On initiation of this treatment the mortality rate of these infants dropped from 62 per cent in 1934 to 15 per cent in 1936. Filmer's description of enzootic marasmus (25) closely parallels Holt's description of infantile marasmus. In subsequent research, Filmer and Underwood (26) determined that enzootic marasmus was due to a deficiency of cobalt. Holt et al. (41) conclude from their research on fat absorption that atrophic infants are deficient in this respect, and they note the unfavorable influence on fat absorption of a diet containing a high concentration of alkaline earths.

The preceding material clearly indicates the probable physiological basis of marasmus rather than the psychological basis postulated by Ribble.

In view of the preceding evidence, Orlansky's (57) criticism of Ribble appears well confirmed: "It is unfortunate that such an influential writer has not attempted to draw a line between her empirical findings and her personal opinions" (57 p. 12).

IV. SUMMARY

Ribble's thesis as developed throughout her articles is essentially that all infantile experiences are of great importance to the direction of the infant's development. In support of this position she contends that the child is very sensitive to his environment, that he lacks adequate organization of his primary body functions to meet the demands of his postnatal world, and that he shows great instability in these body functions. She maintains that there must be a long period of very attentive "mothering" if the infant is to develop normally physiologically, anatomically, and psychologically. In each step in the development of her position she has cited as evidence the "developmental status" of the infant.

This critique has evaluated Ribble's contentions, evidences, and conclusions in the light of most representative, and controlled physiological, anatomical, and psychological experiments, observations, and studies. Almost every one of her points has been refuted by the results of these investigations. Those not refuted are discounted in consequence of considerations more in keeping with the known facts. The most lenient conclusion possible would *deny* the presence of scientific evidence substantiating her general thesis, whereas a conclusion in keeping with the material here presented and with its implications, points to a direct refutation of the thesis itself.

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BREADTH OF BONE AND MUSCLE BY AGE AND SEX IN CHILDHOOD¹

STUDIES BASED ON MEASUREMENTS DERIVED FROM SEVERAL
ROENTGENOGRAMS OF THE CALF OF THE LEG

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Indices of growth and development are desirable when large groups of children must be sorted into usual or normal and unusual or abnormal categories in the shortest possible time (1). Overall gross measurements, such as weight and height, present considerable information, but this information alone does not depict the constituent factors. It is important to differentiate weight into its component parts of muscle, bone and fat. This has been attempted by measuring on A-P roentgenograms of the calf the thickness of the skin and subcutaneous tissue and the breadth of bone and muscle. In the well child, the former indicates primarily the quantity of fat laid down in these tissues and the latter indicates the development of the muscles in the calf (2). Differences in bone structure are relatively unimportant in this region and may be judged to better advantage in other parts. Body height, shoulder, chest and pelvic breadths, and breadths of elbow and knee have all been used as indications of growth in bone, but we are developing standards for breadth of tibial diaphysis and length of tibia based upon data from the roentgenograms referred to above. These measurements all aid in the recognition of a child's physique, and by following them from period to period it is possible to ascertain more specifically the individual's growth patterns and the normalcy of the child's development.

Similarly, it is imperative that any consideration of proportionate amounts of fat, bone and muscle include regard to height and weight. A muscle breadth which may be usual for a tall linear five-year-old boy may be quite inadequate for the child who is short and stocky. A heavy child may have the same amount of muscle as a light child of similar height and two children of the same age, height and weight may have very different amounts of muscle (3). The differences in these instances may be due to a greater or lesser deposit of fat and fluid in the subcutane-

¹ This study is based upon a group of children enrolled for Research on Child Health and Development, under the direction of Harold C. Stuart, Professor of Maternal and Child Health, Harvard School of Public Health. The study was supported (in part) by a Research Grant from the National Institutes of Health, Public Health Service. The author is indebted to Dr. Stuart for valuable assistance in the preparation of this paper.

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ous tissues or to differences in the stockiness of the bony skeleton. Thus height and weight alone cannot present a true picture of the situation.

On the average, individuals show an increase in the breadth of muscle in the calf with increasing age (Table I). This growth occurs at a rapidly

TABLE I
MEAN BREADTH OF BONE AND MUSCLE BY AGE AND SEX

| Age | Boys | | Girls | |
|-------------------------------|----------------|----------------------------|----------------|----------------------------|
| | Size of Sample | Mean \pm S.D.m (in cms.) | Size of Sample | Mean \pm S.D.m (in cms.) |
| a) THREE - FOOT TUBE DISTANCE | | | | |
| 3 months | 84 | 3.586 \pm 0.026 | 92 | 3.401 \pm 0.028 |
| 6 | 78 | 3.914 \pm 0.031 | 87 | 3.786 \pm 0.033 |
| 9 | 73 | 4.244 \pm 0.034 | 76 | 4.109 \pm 0.047 |
| 1 year | 96 | 4.612 \pm 0.040 | 96 | 4.461 \pm 0.045 |
| 1½ years | 74 | 5.027 \pm 0.041 | 75 | 4.904 \pm 0.047 |
| 2 | 96 | 5.272 \pm 0.037 | 99 | 5.178 \pm 0.037 |
| 2½ | 86 | 5.600 \pm 0.049 | 82 | 5.544 \pm 0.047 |
| 3 | 96 | 5.832 \pm 0.047 | 97 | 5.802 \pm 0.045 |
| 3½ | 71 | 6.097 \pm 0.056 | 73 | 6.134 \pm 0.057 |
| 4 | 88 | 6.252 \pm 0.052 | 89 | 6.302 \pm 0.055 |
| 4½ | 68 | 6.493 \pm 0.063 | 77 | 6.490 \pm 0.062 |
| 5 | 86 | 6.541 \pm 0.058 | 84 | 6.573 \pm 0.060 |
| 5½ | 66 | 6.814 \pm 0.067 | 74 | 6.793 \pm 0.067 |
| 6 | 70 | 6.976 \pm 0.057 | 64 | 6.844 \pm 0.064 |
| 6½ | 42 | 6.995 \pm 0.087 | 41 | 7.027 \pm 0.096 |
| 7 | 44 | 7.139 \pm 0.078 | 40 | 7.212 \pm 0.093 |
| 7½ | 28 | 7.282 \pm 0.121 | 34 | 7.238 \pm 0.118 |
| 8 | 32 | 7.406 \pm 0.111 | 32 | 7.325 \pm 0.124 |
| b) SIX - FOOT TUBE DISTANCE | | | | |
| 6 years | 62 | 6.815 \pm 0.069 | 62 | 6.839 \pm 0.070 |
| 7 | 81 | 7.042 \pm 0.060 | 76 | 7.134 \pm 0.066 |
| 8 | 77 | 7.412 \pm 0.069 | 69 | 7.351 \pm 0.078 |
| 9 | 61 | 7.675 \pm 0.080 | 66 | 7.562 \pm 0.082 |
| 10 | 46 | 8.059 \pm 0.107 | 57 | 7.681 \pm 0.099 |
| 11 | 39 | 8.321 \pm 0.109 | 46 | 8.107 \pm 0.123 |
| 12 | 38 | 8.571 \pm 0.114 | 36 | 8.644 \pm 0.159 |
| 13 | 48 | 9.069 \pm 0.130 | 37 | 9.059 \pm 0.180 |
| 14 | 35 | 9.591 \pm 0.160 | 27 | 9.396 \pm 0.157 |
| 15 | 30 | 10.187 \pm 0.186 | 25 | 9.716 \pm 0.168 |
| 16 | 25 | 10.400 \pm 0.215 | 14 | 9.571 \pm 0.239 |

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decelerating rate during the second year, a slowly decelerating rate up to the onset of early puberal changes, an accelerating rate during the period of rapid general adolescent growth, and at a decelerating rate thereafter until growth ceases (Table II). There is considerable variability as seen in this

TABLE II
PERCENTAGE RATE OF INCREASE* IN THE MEAN BREADTH OF BONE AND
MUSCLE BY SUCCESSIVE AGE GROUPS AND SEX

| Age | Three-foot Tube Distance | | Age | Six-foot Tube Distance | |
|---------------------|-----------------------------|-------|---------------|---------------------------|-------|
| | Boys | Girls | | Boys | Girls |
| Birth to 6 mo. | Data unavailable | | 6 to 7 | 3.3% | 4.3% |
| 6 mo. to 1 yr. | 17.8% | 17.8% | 7 to 8 | 5.3 | 3.0 |
| 1 to 1½ | 9.0 | 9.9 | 8 to 9 | 3.5 | 2.9 |
| 1½ to 2 | 4.9 | 5.6 | 9 to 10 | 5.0 | 1.6 |
| 2 to 2½ | 6.2 | 7.1 | 10 to 11 | 3.3 | 5.5 |
| 2½ to 3 | 4.1 | 4.7 | 11 to 12 | 3.0 | 6.6 |
| 3 to 3½ | 4.5 | 5.7 | 12 to 13 | 5.8 | 4.8 |
| 3½ to 4 | 2.5 | 2.7 | 13 to 14 | 5.8 | 3.7 |
| 4 to 4½ | 3.9 | 3.0 | 14 to 15 | 6.2 | 3.4 |
| 4½ to 5 | 0.7 | 1.3 | 15 to 16 | 2.1 | -1.5 |
| 5 to 5½ | 4.2 | 3.3 | | | |
| 5½ to 6 | 2.4 | 0.8 | | | |
| 6 to 6½ | 0.3 | 2.7 | | | |
| 6½ to 7 | 2.1 | 2.6 | | | |
| 7 to 7½ | 2.0 | 0.4 | | | |
| 7½ to 8 | 1.7 | 1.2 | | | |

$$\text{* Rate of increase (\%)} = \left[\frac{m_{x+T} - m_x}{m_x} \right] 100$$

where: m_x = value of the mean at age X

T = any interval of time

m_{x+T} = value of the mean at the age $X + T$

table from age period to age period, which may be explained partially by the variations due to small samples at certain ages.

In attempting to analyze the growth of muscle, and of skin and subcutaneous tissue, the breadth measurements described here are not directly applicable. Measurements are taken on a plane through the center of the leg, but the leg is actually a more or less cylindrical mass of bone and muscle circumscribed by a ring of skin and subcutaneous tissue. It must be borne in mind that the plane measurements on the X-ray film are merely functions of these cylindrical and ring-shaped volumes.

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Furthermore, consideration must be given to the X-ray technique, itself. The angle of light for roentgenograms taken at three-foot tube-film distance becomes more oblique as the leg size increases. This tends to distort the X-ray and results in a slightly broader shadow. At ages six, seven, and eight the averages (in centimeters) for the three- and six-foot X-rays of boys are respectively: 6.98 and 6.81; 7.14 and 7.04; and 7.41 and 7.41, and for girls: 6.84 and 6.84; 7.21 and 7.13; and 7.32 and 7.35. These differences are approximately of the magnitude of the growth occurring during one half year. However, since actual sizes are not of importance but only relative position of the child's measurement within the range, and since norms for reference for the appropriate tube distance are always used, errors of interpretation due to these technical factors are greatly reduced. Furthermore, at age six the standard deviation for either the three-foot or six-foot measurements is approximately 0.49 while the residual standard error, obtained from the differences between the two techniques, is 0.14. This residual variation is an estimation of the error in measurement as the systematic error between the two methods has been removed, but there is included in the value a third type of error. As has been previously stated, the amount of distortion of the X-ray shadow by the three-foot and six-foot techniques varies according to the size of the calf. Thus, even within one age group the difference in measurement observed between the two methods will vary from child to child becoming greater as the calf becomes larger. This error between the individuals themselves is included in the residual variation, but for practical purposes its removal would be fallacious as the variation would become smaller and more dependence might be placed on smaller differences. This could lead to erroneous conclusions, for the radiologist must secure roentgenograms of children of varying leg size. It can be concluded that the best practical residual standard error will include errors in measurement and errors between the individuals as a result of size differences, both technical errors. This variation of 0.14 is a sizable proportion of the total variation. Thus, if by technique alone, differences of this magnitude are introduced it becomes doubly important for variations from the averages presented in this paper to be considered carefully in the light of other variables (height, weight, etc.) before any conclusion is drawn. However, gross or consistent differences between individuals are worthy of note.

Table III and Figure 1 present the 10th, 25th, 50th, 75th and 90th percentiles, as well as the means and standard deviations for the two categories (breadth of bone and muscle, and breadth of skin and subcutaneous tissue), according to age and sex. Similar measurements on A-P roentgenograms of the calf for individual children may be compared with these norms enabling the pediatrician to allocate numerically the child's weight into its component parts. Thus, a seven-year-old boy weighing 26.6 kgms. (58¾ lbs.), whose height was 124.2 cms., whose X-ray breadth of bone

TABLE III
NORMS FOR BREADTH OF BONE AND MUSCLE (in cms.)

| Age | B O Y S | | | | | | G I R L S | | | | | | | | | |
|----------|---------------------|------|-----|-----|------|------|-----------------|------|-----|-----|------|-----|-----|------|------|----|
| | Percentiles | | | m | S.D. | n | Percentiles | | | m | S.D. | n | | | | |
| | 10th | 25th | M | | | | 10th | 25th | M | | | | | | | |
| | T H R E E - F O O T | | | | | | D I S T A N C E | | | | | | | | | |
| 3 months | 3.3 | 3.4 | 3.6 | 3.8 | 3.9 | 3.59 | 0.24 | 84 | 3.1 | 3.2 | 3.4 | 3.6 | 3.7 | 3.40 | 0.26 | 92 |
| 6 | 3.6 | 3.6 | 3.9 | 4.2 | 4.3 | 3.91 | 0.28 | 78 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 3.79 | 0.31 | 87 |
| 9 | 3.9 | 4.0 | 4.2 | 4.4 | 4.6 | 4.24 | 0.29 | 73 | 3.7 | 3.8 | 4.1 | 4.3 | 4.6 | 4.11 | 0.41 | 76 |
| 1 year | 4.2 | 4.4 | 4.6 | 4.8 | 5.1 | 4.61 | 0.39 | 96 | 4.0 | 4.2 | 4.5 | 4.8 | 5.0 | 4.46 | 0.44 | 96 |
| 1½ | 4.5 | 4.8 | 5.0 | 5.2 | 5.5 | 5.03 | 0.35 | 74 | 4.4 | 4.6 | 5.0 | 5.2 | 5.4 | 4.90 | 0.40 | 75 |
| 2 | 4.8 | 5.0 | 5.2 | 5.5 | 5.7 | 5.27 | 0.36 | 96 | 4.6 | 5.0 | 5.2 | 5.4 | 5.6 | 5.18 | 0.37 | 99 |
| 2½ | 4.9 | 5.4 | 5.6 | 5.9 | 6.1 | 5.60 | 0.45 | 86 | 4.9 | 5.4 | 5.6 | 5.8 | 6.0 | 5.54 | 0.42 | 82 |
| 3 | 5.3 | 5.6 | 5.8 | 6.1 | 6.4 | 5.83 | 0.46 | 96 | 5.2 | 5.5 | 5.8 | 6.2 | 6.4 | 5.80 | 0.45 | 97 |
| 3½ | 5.6 | 5.6 | 6.2 | 6.4 | 6.6 | 6.10 | 0.47 | 71 | 5.5 | 5.8 | 6.2 | 6.4 | 6.8 | 6.13 | 0.49 | 73 |
| 4 | 5.7 | 5.8 | 6.2 | 6.6 | 6.8 | 6.25 | 0.49 | 88 | 5.6 | 6.0 | 6.3 | 6.6 | 7.0 | 6.30 | 0.52 | 89 |
| 4½ | 5.7 | 6.1 | 6.5 | 6.8 | 7.1 | 6.49 | 0.52 | 68 | 5.8 | 6.1 | 6.5 | 6.8 | 7.2 | 6.49 | 0.54 | 77 |
| 5 | 5.8 | 6.2 | 6.5 | 6.9 | 7.2 | 6.54 | 0.53 | 86 | 5.9 | 6.2 | 6.5 | 7.0 | 7.2 | 6.57 | 0.55 | 84 |
| 5½ | 6.1 | 6.4 | 6.8 | 7.2 | 7.4 | 6.81 | 0.54 | 66 | 6.0 | 6.4 | 6.8 | 7.3 | 7.5 | 6.79 | 0.58 | 74 |
| 6 | 6.3 | 6.6 | 7.0 | 7.3 | 7.6 | 6.98 | 0.48 | 70 | 6.2 | 6.4 | 6.8 | 7.2 | 7.6 | 6.84 | 0.51 | 64 |
| | S I X - F O O T | | | | | | D I S T A N C E | | | | | | | | | |
| 6 | 6.2 | 6.4 | 6.8 | 7.2 | 7.4 | 6.81 | 0.55 | 62 | 6.0 | 6.4 | 6.9 | 7.2 | 7.5 | 6.84 | 0.55 | 62 |
| 7 | 6.4 | 6.6 | 7.0 | 7.5 | 7.7 | 7.04 | 0.54 | 81 | 6.4 | 6.8 | 7.1 | 7.5 | 7.9 | 7.13 | 0.57 | 76 |
| 8 | 6.6 | 7.1 | 7.4 | 7.8 | 8.2 | 7.41 | 0.61 | 77 | 6.4 | 6.8 | 7.4 | 7.8 | 8.3 | 7.35 | 0.65 | 69 |
| 9 | 7.0 | 7.2 | 7.7 | 8.0 | 8.5 | 7.68 | 0.63 | 61 | 6.8 | 7.1 | 7.4 | 8.0 | 8.5 | 7.56 | 0.67 | 66 |

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TABLE III (continued)

| Age | B O Y S | | | | | G I R L S | | | | | | | | | | |
|-----|-------------|------|------|------|------|-------------|------|----|------|------|-----|------|------|------|------|----|
| | Percentiles | | | | | Percentiles | | | | | | | | | | |
| | 10th | 25th | M | 75th | 90th | m | S.D. | n | 10th | 25th | M | 75th | 90th | m | S.D. | n |
| 10 | 7.0 | 7.6 | 8.0 | 8.6 | 8.9 | 8.06 | 0.72 | 46 | 6.8 | 7.1 | 7.6 | 8.2 | 8.8 | 7.68 | 0.75 | 57 |
| 11 | 7.5 | 7.8 | 8.3 | 8.8 | 9.4 | 8.32 | 0.68 | 39 | 7.2 | 7.4 | 7.9 | 8.9 | 9.2 | 8.11 | 0.84 | 46 |
| 12 | 7.7 | 8.3 | 8.6 | 9.0 | 9.5 | 8.57 | 0.70 | 38 | 7.3 | 7.8 | 8.7 | 9.2 | 10.1 | 8.64 | 0.95 | 36 |
| 13 | 7.9 | 8.4 | 8.9 | 9.4 | 10.3 | 9.07 | 0.90 | 48 | 7.6 | 8.1 | 9.1 | 9.9 | 10.6 | 9.06 | 1.09 | 37 |
| 14 | 8.4 | 8.9 | 9.5 | 10.3 | 10.9 | 9.59 | 0.95 | 35 | 8.4 | 8.6 | 9.2 | 10.1 | 10.8 | 9.40 | 0.82 | 27 |
| 15 | 8.3 | 9.6 | 10.2 | 10.8 | 11.3 | 10.19 | 1.02 | 30 | 8.7 | 9.1 | 9.6 | 10.1 | 11.3 | 9.72 | 0.84 | 25 |
| 16 | 9.0 | 9.8 | 10.3 | 11.2 | 11.4 | 10.40 | 1.07 | 25 | 8.3 | 9.0 | 9.3 | 10.1 | 10.8 | 9.57 | 0.89 | 14 |

REVISED NORMS FOR BREADTH OF SKIN AND SUBCUTANEOUS TISSUE (in cms.)*

| | S I X - F O O T | | | | | T U B E | | | | | D I S T A N C E | | | | | |
|----|-----------------|-----|-----|-----|-----|---------|------|----|-----|-----|-----------------|-----|-----|------|------------------|----|
| | 0.8 | 0.9 | 1.0 | 1.1 | 1.3 | 1.03 | 0.22 | 62 | 1.0 | 1.1 | 1.3 | 1.5 | 1.6 | 1.29 | 0.26 | |
| 6 | 0.8 | 0.9 | 1.0 | 1.1 | 1.3 | 1.03 | 0.22 | 62 | 1.0 | 1.1 | 1.3 | 1.5 | 1.6 | 1.29 | 0.26 <td>62</td> | 62 |
| 7 | 0.7 | 0.9 | 1.0 | 1.2 | 1.4 | 1.04 | 0.30 | 81 | 1.0 | 1.2 | 1.3 | 1.5 | 1.6 | 1.33 | 0.28 | 76 |
| 8 | 0.8 | 0.9 | 1.0 | 1.2 | 1.5 | 1.08 | 0.30 | 77 | 1.0 | 1.2 | 1.4 | 1.5 | 1.8 | 1.37 | 0.31 | 69 |
| 9 | 0.8 | 0.8 | 1.0 | 1.2 | 1.4 | 1.09 | 0.36 | 61 | 1.0 | 1.2 | 1.4 | 1.6 | 1.9 | 1.43 | 0.35 | 66 |
| 10 | 0.8 | 0.9 | 1.0 | 1.2 | 1.4 | 1.04 | 0.24 | 46 | 1.1 | 1.2 | 1.5 | 1.7 | 2.2 | 1.55 | 0.41 | 57 |
| 11 | 0.8 | 0.8 | 1.1 | 1.2 | 1.5 | 1.09 | 0.27 | 39 | 1.1 | 1.3 | 1.5 | 1.7 | 2.0 | 1.50 | 0.33 | 46 |
| 12 | 0.8 | 0.9 | 1.1 | 1.5 | 1.7 | 1.20 | 0.35 | 38 | 1.1 | 1.3 | 1.6 | 1.8 | 2.2 | 1.63 | 0.39 | 36 |
| 13 | 0.7 | 0.9 | 1.2 | 1.6 | 1.9 | 1.32 | 0.59 | 48 | 1.3 | 1.5 | 1.8 | 2.4 | 2.4 | 1.74 | 0.42 | 37 |
| 14 | 0.7 | 1.0 | 1.2 | 1.6 | 1.9 | 1.37 | 0.65 | 35 | 1.4 | 1.6 | 1.8 | 2.0 | 2.6 | 1.89 | 0.47 | 27 |
| 15 | 0.7 | 0.9 | 1.0 | 1.5 | 1.8 | 1.22 | 0.50 | 30 | 1.5 | 1.7 | 1.9 | 2.1 | 2.4 | 1.94 | 0.45 | 25 |
| 16 | 0.6 | 0.8 | 1.0 | 1.2 | 1.5 | 1.05 | 0.44 | 25 | 1.7 | 1.7 | 1.9 | 2.1 | 2.3 | 1.94 | 0.24 | 14 |

* Skin and subcutaneous tissue values for 3 months to 5½ years were obtained from Stuart and Sobel.

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and muscle was 8.2 cms., and whose breadth of skin and subcutaneous tissue was 1.0 cms., can be said to be heavy for his age and height primarily due to a heavy musculature (relatively large muscle mass); while

BREADTH OF TISSUE

MEASURED ON A-P ROENTGENOGRAMS OF THE CALF,
BY AGE AND SEX

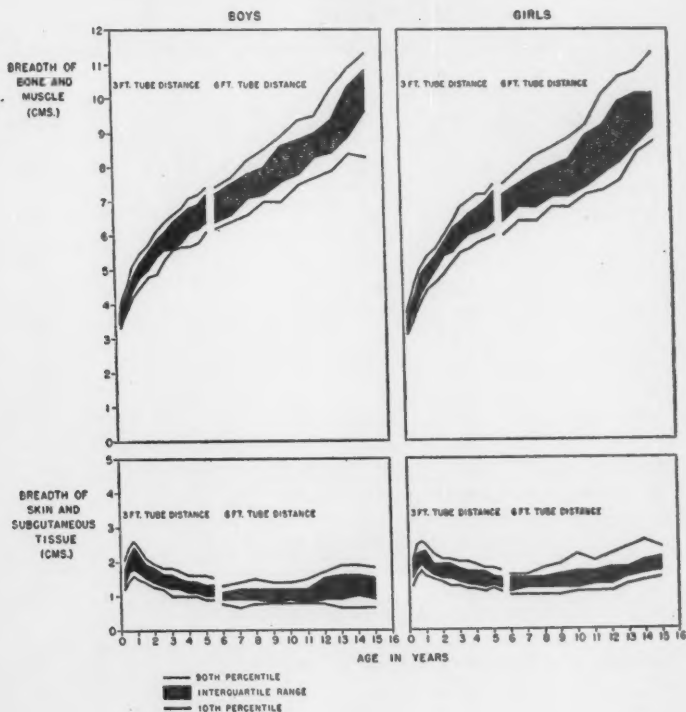


FIGURE 1

another seven-year-old boy weighing 26.3 kgms. (58 lbs.), who was 123.8 cms. in height, and whose X-ray breadth of bone and muscle was 7.0 cms., while his breadth of skin and subcutaneous tissue was 1.2 cms., was approximately the same according to age, height and weight, but his muscle

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mass was average, the equal weight being due at least partially to a slight excess of fat.²

The ratios of the average breadth of skin and subcutaneous tissue to the average breadth of bone and muscle are given in Table IV for each

TABLE IV
MEAN RATIO OF SKIN AND SUBCUTANEOUS TISSUE TO BONE AND
MUSCLE BY AGE AND SEX*

| Age† | Three-foot Tube Distance | | Age | Six-foot Tube Distance | |
|----------|-----------------------------|-------|---------|---------------------------|-------|
| | Boys | Girls | | Boys | Girls |
| 3 months | 42% | 50% | 6 years | 15% | 19% |
| 6 months | 49 | 50 | 7 | 15 | 19 |
| 9 months | 49 | 51 | 8 | 15 | 19 |
| 1 year | 41 | 43 | 9 | 14 | 19 |
| 1½ years | 34 | 37 | 10 | 13 | 20 |
| 2 | 30 | 33 | 11 | 13 | 19 |
| 2½ | 25 | 31 | 12 | 14 | 19 |
| 3 | 24 | 28 | 13 | 15 | 19 |
| 3½ | 21 | 24 | 14 | 14 | 20 |
| 4 | 21 | 24 | 15 | 12 | 20 |
| 4½ | 18 | 22 | 16 | 10 | 20 |
| 5 | 18 | 21 | | | |
| 5½ | 18 | 21 | | | |
| 6 | 16 | 20 | | | |

$$\text{* Ratio (\%)} = \left\{ \frac{\text{Mean Breadth of Skin and Subcutaneous Tissue}}{\text{Mean Breadth of Bone and Muscle}} \right\} 100$$

Note: If the average breadth of skin and subcutaneous tissue equals the average breadth of bone and muscle, this ratio would be one hundred.

† Skin and subcutaneous tissue measurements for 3 mos. to 6 yrs. inclusive on 3-ft. tube distance taken from Stuart and Sobel.

² Percentile ranks for the two boys:

| | Boy A | Boy B |
|---------|-----------------|--------------------|
| Height* | M approximately | M approximately |
| Weight* | 75th | 75th approximately |
| Muscle | Above 90th | M |
| Fat | M | 75th |

* Stuart-Meredith (1).

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age and sex. Girls appear to have proportionally more subcutaneous tissue and less bone and muscle than boys throughout life which confirms the findings of Reynolds (3). Furthermore, the proportion of fat to muscle varies with age. The breadths of calves for the group of infants at three,

TABLE V
COEFFICIENTS OF VARIATION FOR MEASUREMENTS OF BREADTH
OF BONE AND MUSCLE BY AGE AND SEX

| <i>Age</i> | Three-foot Tube Distance | | <i>Age</i> | Six-foot Tube Distance | |
|------------|-----------------------------|--------------|------------|---------------------------|--------------|
| | <i>Boys</i> | <i>Girls</i> | | <i>Boys</i> | <i>Girls</i> |
| 3 months | 6.7% | 7.8% | 6 years | 8.0% | 8.0% |
| 6 months | 7.1 | 8.1 | 7 | 7.7 | 8.0 |
| 9 months | 6.9 | 9.9 | 8 | 8.2 | 8.8 |
| 1 year | 8.4 | 9.9 | 9 | 8.2 | 8.9 |
| 1½ years | 7.0 | 8.3 | 10 | 9.0 | 9.7 |
| 2 | 6.8 | 7.1 | 11 | 8.2 | 10.3 |
| 2½ | 8.1 | 7.7 | 12 | 8.2 | 11.0 |
| 3 | 7.9 | 7.7 | 13 | 9.9 | 12.1 |
| 3½ | 7.7 | 8.0 | 14 | 9.9 | 8.7 |
| 4 | 7.8 | 8.3 | 15 | 10.0 | 8.6 |
| 4½ | 8.0 | 8.4 | 16 | 10.3 | 9.3 |
| 5 | 8.2 | 8.4 | | | |
| 5½ | 8.0 | 8.5 | | | |
| 6 | 6.8 | 7.4 | | | |
| 6½ | 8.0 | 8.8 | | | |
| 7 | 7.2 | 8.2 | | | |
| 7½ | 8.8 | 9.5 | | | |
| 8 | 8.5 | 9.6 | | | |

six, and nine months on the average were nearly 50 per cent fat; but by one year of age the ratios had commenced to decline and at age 16 the proportion of fat to muscle was 10 per cent for boys and 20 per cent for girls.

The coefficient of variation for measurements of breadth of bone and muscle are given in Table V and Figure 2. Girls tend to show somewhat more variation through age 10, after which age their variation increases markedly above that for boys. This increase in variation around the mean coincides with the prepubertal growth spurt for girls. By age 14, when the majority of the girls had passed through this period of accelerated growth,

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the variation had decreased to a point lower than that for the boys. Whether the boys evidence this same increase in variation has not been determined, for the number of boys who have passed their rapid pubertal growth is still small.

COEFFICIENT OF VARIATION FOR MEASUREMENTS OF BREADTH OF BONE AND MUSCLE IN THE CALF, BY AGE AND SEX

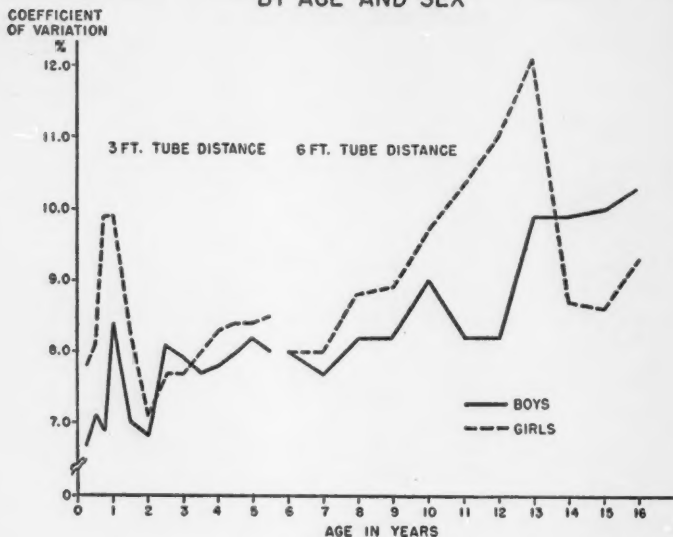


FIGURE 2

CONCLUSION

Measurements of the breadth of the tissues in the calf of the leg vary with the age and sex of the child. Norms are presented by which the measurements for individual children may be compared with those for a large group. Although the time and expense involved in the application of this roentgenographic technique prohibit its use as a routine in following the growth of normal infants and children, the relationships which it reveals in respect to variations by age, sex, body build and the like are of value in leading to a better understanding of child development and the interpretation of physical status. The procedure has clinical value in following the growth progress of occasional children who deviate markedly from normal patterns.

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THE IMPACT OF BEGINNING FIRST GRADE UPON SOCIALIZATION AS REPORTED BY MOTHERS

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SETTING AND PURPOSE OF THE STUDY

Each year over two million six-year-olds enter first grade in our public schools. This is a unique experience for them; for many it may represent the initial protracted experience with a socializing agent outside the home; for many it may be their first large group contact; for most, even for those who have had preschool, it undoubtedly brings pressures and demands hitherto not felt. It was our thesis in conducting this study that the experience of beginning first grade plays an important part in the socialization of the child; it was our purpose to tentatively explore certain aspects of this experience through interviews with mothers.

We began with descriptions of "sixness" found in the literature. Gesell and Ilg have reported that this is "a trying age" for many a parent. The child is described as difficult, aggressive, explosive, demanding; his behavior is fresh, nasty, insulting, impudent, bratty, rude and argumentative. This is in sharp contrast to his behavior at five when he was "in focus," cooperative, friendly, sympathetic, affectionate, helpful. Following are the affective attitudes listed for six years: (7, p. 289-290)

6 Years—Highly emotional. Marked disequilibrium between child and others.

Expansive and undifferentiated. Good or bad; sweet or horrid; adoring or cruel.

He knows "everything"; boasts, brags.

Likes praise and approval; resents correction and is easily hurt by a cross word.

Loves or hates mother.

Rapidly explosive with crying, strikes out physically or verbally, or has temper tantrums.

Quarrelsome, argumentative, explosive, rebellious, rude, "fresh," stubborn, brash.

Noisy, boisterous and easily excitable.

Silly, giggling, grimacing, showing off.

Resents direction, but is also over-conforming.

Domineers, blames and criticizes others, alibis.

Glowers and glows; has fire or a twinkle in his eye.

At times angelic, generous, companionable.

Jealous of possessions of other children.

May not be too responsive to *humor* at this age.

Uses language aggressively: calls names, threatens, contradicts, argues, uses mild profanity.

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But while these writers are willing at this point to accept the picture of sixness as Gesell and Ilg present it, they do question the assumption of the Yale school that the kind of behavior observed at this age level is developmental as they have defined the term. Gesell and Ilg state that the changing patterns of behavior seen in the young child "are not the product of the contemporary environment; they are primarily the expressions of the ancient processes of evolution. . . . In some condensed way the child must retroverse these immense ages. . . . In the vast complexities of his nervous system he matches the vastness of his ancestral past" (7). The writers question this theory which implies a universality and inevitability of developmental stages, a theory which is not substantiated by evidence from other cultures. It is the writers' thesis that six may indeed be a difficult stage but that this is due to the fact that the socialization process is being changed in important ways by the experience of beginning first grade. Some of these possible changes are described below.

1. It was postulated that entrance to first grade is highly significant in the minds of sixes and may bring about certain changes in the child's conception of himself. In order to understand the nature of these changes in self-concept, it is necessary to look at socialization during the child's first six years. Freudian psychology has given us a picture of an infant who brings with him into the world

an unorganized chaotic mentality called the id, the sole aim of which is the gratification of all needs, the alleviation of hunger, self-preservation, and love, the preservation of the Species. However, as the child grows older, that part of the id which comes in contact with the environment through the senses learns to know the inexorable reality of the outer world and becomes modified into . . . the ego. This ego, possessing awareness of the environment, henceforth strives to curb the lawless id tendencies whenever they attempt to assert themselves incompatibly (3).

While there are many aspects of ego-development which might be considered, the aspect which seems appropriate for this study involves the development of the concept of self. This concept of what is self and what is not-self gradually emerges as the child learns to differentiate himself from his mother. However, because he has been living in an environment which centers around him, his early perceptions of self take the form of "infantile omnipotence" and he sees other individuals only as servants to self. But when he begins walking and talking and becomes part of total society, his actions are curbed. There are more and more prohibitions upon his behavior, so that he may lose some of his feelings of omnipotence and come to a more realistic concept of self.

The experience of beginning first grade, however, may serve as a shot in the arm to bolster the deflated ego. This experience is one that is drama-

tized considerably in our culture. By the way in which adults discuss school entrance with the child ("So you're going to FIRST GRADE in the Fall"), from remarks of adults and their children concerning future school activities, even from his new haircut and new clothes for the event, the young child gets a feeling of participating in a great and important adventure in which older children whom he recognizes as having age-status, are already participating. Furthermore, it is an adventure in which all sixes share; our culture says at six one leaves home and goes to formal school. To the young child entrance to first grade may seem a major step in the process of growing up, as important as certain initiation ceremonies at puberty in primitive tribes. It is a step away from babyhood and home into the world of peers and older children. It may bring with it feelings of increased self-importance, self-esteem and of ego-identity.

Erikson has described similar effects upon ego of another important growth experience:

In turning from the consideration of groups to that of individuals, let me postulate that the growing child must derive a vitalizing sense of reality from the awareness that his individual way of mastering experience (his ego synthesis) is a successful variant of a group identity and is in accord with its space-time and life plan.

A child who has just found himself able to walk seems not only driven to repeat and to perfect the act of walking by libidinal pleasure in the sense of Freud's locomotor eroticism; or by the need for mastery in the sense of Ives Hendrick's work principle; he also becomes aware of the new status and stature of "he who can walk," with whatever connotation this happens to have in the coordinates of his culture's life plan—be it "he who will go far," or "he who will be upright," or "he who might go too far." To be "one who can walk" becomes one of the many steps in child development which through the coincidence of physical mastery and cultural meaning, of functional pleasure and social recognition, contribute to a more realistic self-esteem. By no means only a narcissistic corroboration of infantile omnipotence (that can be had more cheaply), this self-esteem grows to be a conviction that the ego is learning effective steps toward a tangible collective future, that it is developing into a defined ego within a social reality. This sense I wish to call ego-identity (4).

But there are other ways, conflicting ones, in which the child's concept of self may be changed. In first grade the child also sees himself in comparison with other children. He comes to a new and realistic conception of self as he learns that others surpass him in certain skills or that he surpasses them. The feelings of self-importance, of independence which accompany entrance to school, may give way to self-reality and self-deflation as time goes on. As the child tries to assimilate these conflicting self-ideas into the ego, he may show signs of the conflict in the erratic and "unsocialized" behavior described by Gesell and Ilg.

This is not to assume that all children will behave alike with regard to ego-development at six. Ausubel has analyzed the reorganization of ego-

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structure that takes place during the initial devaluation period at three years of age. According to his analysis, either satellization or incorporation occurs. In the process of satellization,

the child identifies as a subordinate figure in relation to the dominant role of the parents. By virtue of his complete acceptance of this dependent position, he becomes automatically assured of intrinsic feelings of security and adequacy,—providing, of course that he is emotionally accepted and valued for his own sake. The rejected child obviously cannot satellize, and is hence compelled to cling to his former untenable ego structure. The extrinsically-valued child—unassured of appreciation for his own sake—is placed in the same position: To remain adequate in his own eyes he feels obliged to fulfill the grandiose pretensions of his infantile ego which his ambitious parents do nothing to deflate. However, in the latter case, the retention of the infantile structure is quite compatible with the adulation with which he is surrounded; whereas in the face of a hostile environment, the rejected child must harbor his omnipotent fancies within (1).

If Ausubel's analysis is correct, it might follow that the satellizing child would differ from the incorporating child in his adjustment to first grade, not only in the way in which he is able to assimilate ambivalent feelings of importance and nonimportance, but also in his acceptance or nonacceptance of dependency relations with the teacher. But, while we admit differences in the effects of school entrance upon children, we see our first job as the more gross one of discovering what, if any, changes in self-concept occur with first-grade entrance.

2. It was further postulated that the changes in behavior described by Gesell and Ilg as occurring at six might be due to the fact that a new socializing agent in the form of the teacher has been introduced. For most first-graders, this is their first experience with a socializing agent outside the home. Even for those who have attended preschool, the concept may be one that is only imperfectly learned at six years of age. Some evidence for the statement that the child recognizes the teacher as a socializing agent may be found in the play life of the young child as he dramatizes the role of the teacher. It is common knowledge that the young child loves to play school. In his play, he typically portrays the teacher as a stern, strict disciplinarian, even though she may be nothing of the sort. By the very intensity with which he plays this exaggerated role, he may be revealing that he sees the teacher as a socializing agent.

And where the child has established satisfactory relations with his mother, the mother-surrogate may present no difficulties, *provided* he sees her as the same kind of socializer as his mother. But where there have been maternal conflicts in preschool years, or where the teacher makes demands that are too different for the child, we may expect behavior difficulties. This, however, is getting ahead of our story. What we were interested in finding out in this study was whether mothers reported changes for the

worse, as described by Gesell and Ilg, occurring with first-grade entrance, and the introduction of a new socializing agent. With this knowledge in our possession we could then set up hypotheses to explain differences in adjustment to school, to be tested by more rigorous experimental procedures.

Another aspect of the school experience which may influence the socialization process is that the child now has extended group contacts, and that the peer group may introduce important new learnings. The child learns many things from his peers and many of these learnings come the hard way. He learns from them to take frustration. He learns not to cry on the playground and not to be outstandingly different. But some children may also learn as early as Grade I that one can more easily risk losing an adult's acceptance if one has the support of his peer group. The authority of adults may become weakened as the child grows to appreciate that one can't win with adults by oneself, but one can put up a pretty good battle with one's peers behind one. The process may be analogous to that described by Arnold Green in his report on Polish lower-class family life as seen in a New England community. Green comments on the fact that in large families it is possible for a boy or girl to oppose his parents because he knows he will have the support of one or more of his siblings; his personal security is not threatened by his bid for moral autonomy as is the security of the only child who stands alone in his defiance of parental authority (9). In other words, in the process of growing up, it is necessary to say "no" to one's parents; it is necessary to disobey them. It is easier to risk the possible loss of affection when one has the support of siblings. The same thing may be true in school. The child may have the courage to oppose the authority of the teacher because he knows his peers are behind him, and this knowledge may give tremendous impetus to his growth in independence.

Furthermore, his peers may have standards different from his parents. Margaret Mead in a discussion of cultural surrogates has emphasized the importance of our dependence upon age-mate surrogates in our culture. She says,

Now it is a recognized feature of our society that children soon after starting school begin to substitute the standards of other children for the standards set by their parents . . . The surrogates who carry the cultural standards have changed. They are no longer the parents, omnipotent and belonging to another order of being, but one's everyday companions, with the same strengths and weaknesses as oneself . . . The rejection of parental standards in favor of late-recognized and antagonistic age-grade standards results, therefore, in an attenuation of self-respect and a weakening of the internalized standards (11).

Again, this is not to say that many children at the first-grade level will take even very tentative steps in the direction of substituting age-mate standards for parental standards. Instead of finding identity with the group,

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many will see themselves in a mother-surrogate-sibling relationship in school, as the high evidence of tattling to the teacher and battles with peers at six might indicate. If we accept Ausubel's analysis, it may be that the incorporator more quickly adopts agemate standards, while the satellizer transfers his dependency attitudes from mother to teacher if the circumstances are right. But again, this is getting ahead of our story. Our purpose in presenting this point of view is merely to explain why it was conceivable for us to expect that some mothers would report the child as "sassy," "impudent," "brash," since beginning school, as Gesell and Ilg have described.

3. There was still another hunch to be explored in this study of the impact of public school entrance on socialization and that was in the area of social class differences. However this area will be discussed in a subsequent publication.

This, then, was our theoretical framework. With it in mind we constructed the two schedules to be used in interviewing mothers. These are reproduced at the end of this report. The two main theses we attempted to explore were: (1) Entrance to first grade is highly significant in the minds of sixes and may bring about certain changes in the child's concept of self. This is because of cultural expectations, dramatization of the event, and because the child sees it as his initiation into the outside world. (2) Difficulties in adjustment at six may be due to the fact that the socialization process is disturbed by the effects of first-grade entrance with its accompanying pressures for new adjustments.

PROCEDURES

Two interviews were conducted with mothers of first-grade children, one interview just prior to the child's entrance to first grade, the second after he had been in school for approximately two months and had received his first report card. The interviews were carried out in a Midwestern community by ten different interviewers. A sample of public schools was taken, then a sample of 250 parents whose children were to enter first grade in the fall. Two interviews were completed with 212 of this group.

Median age of the group was 6.3 years as of September 1, just prior to entering school.

Using the technique worked out by Warner and Eells (14) the parents were typed as to social class. Occupation, house type, dwelling area and source of income were used in class typing. Five social classes were defined with distribution as follows:

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| <i>Social Class</i> | <i>Per Cent</i> |
|---------------------|-----------------|
| Upper | 4 |
| Upper-Middle | 24 |
| Lower-Middle | 29 |
| Upper-Lower | 36 |
| Lower-Lower | 7 |

RESULTS

In reading the following section, it should be kept in mind that the information presented here is what mothers have chosen to tell.

1. Entrance to first grade is highly significant in the minds of sixes and may bring about certain changes in the child's concept of self. This is because of cultural expectations, dramatization of the event, and because the child sees it as his initiation into the outside world.

In our first interview we asked certain questions with regard to expectation of and preparation for first grade. From mothers' reports of the child's expectations it would seem that he does regard first-grade entrance as a landmark in the growing up process. In the first interview 197 mothers reported that the child was looking forward to school, as compared with 15 mothers where the child was not. Furthermore, parents' answers indicated a high degree of eagerness to enter school as well as the important place in the child's mind school entrance held. "He's raring to go." "He can hardly wait," "It's all he talks about," were typical responses to the question. Where children were negative, mothers told us they had had unfortunate preschool experiences, or were closely tied to home and mother.

All of our beginners, according to mothers, had been exposed to certain kinds of information regarding school. Brothers, sisters, neighbor children had plied him with ideas, some of which were quite favorable and which built up in the child a picture of school as a pleasant place where one did agreeable duties and had a nice teacher. But 17 of our mothers reported that their child had been exposed to adverse criticism of the school. Children were told "Wait till you get to first grade, boy, you'll have to work," "It's not play, boy, you'll have homework and everything. You can't color all day like in kindergarten," "You'd better be good or you get sent to the principal"—or the hall, or spanked or what have you. But regardless of what he was told, according to most of our mothers the first-grader was still "raring to go." Rather than discouraging him, it would seem that such tales only emphasized the fact that he was leaving his babyhood behind and getting ready to enter the new world of the "big kids."

The six-year-old goes to school to learn to read, to write, and to figure, according to our parents. One hundred seventeen responses indicated that

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as the parents saw it, their child was expecting to work and to learn certain specific skills. The six-year-old expects to have books of his own in his own desk, and to work rather than play in school. Here are the anticipated learnings as reported by mothers. It should be noted that anticipated learnings total more than 100 per cent because some mothers mention more than one learning.

| <i>Learnings</i> | <i>Per Cent of Children Anticipating (according to mothers)</i> |
|-------------------------------|---|
| Reading | 56 |
| Writing | 30 |
| Creative Activities | 25 |
| Social Activities | 16 |
| Number | 14 |
| Discipline | 5 |
| Miscellaneous Responses | 25 |

The high incidence of reading and writing learnings might be explained by the fact that these are the learnings which the parents want most for their children and that in telling us what children expect to learn in school, mothers are really telling us what *they* expect the children to learn. Yet when we asked what would parents like most for their children to get out of school during the first year, the picture is different in certain respects. Here are the learnings mothers want for their children:

| <i>Learnings</i> | <i>Per Cent of Mothers Desiring</i> |
|-------------------------|-------------------------------------|
| Reading | 54 |
| Writing | 22 |
| Creative | 8 |
| Social Adjustment | 31 |
| Number | 14 |
| Discipline | 28 |
| Special Problems | 8 |
| Miscellaneous | 25 |

A comparison of the two tabulations shows that mothers' desires and their reports of what children expect from school are much alike with regard to the 3 R's, but mothers do not emphasize creative activities as much as do the children, and mothers want more in the way of social adjustment, discipline and attention to special problems. Either parents do not communicate their hopes that the school will improve a child's speech

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defect or help him get over his shyness, or they do not think children perceive such hopes.

Mothers reported a variety of answers to the questions, "What have his parents told him about school?" and "What has he been taught?" While many parents do not tell the child much about the school program (partly because they realize schools have changed and partly because the schools have asked them not to) they do try to prepare the child in other ways. In general, the six-year-old knows the alphabet, some nursery rhymes, can write his name, count, sing, and in some cases, can read. Social class differences in relation to these learnings will be reported in a later paper.

More important from the standpoint of our problem, the school has been presented as a socializing agency. The child has been told that he must

TABLE I
EXPECTATION-PREPARATION FOR FIRST GRADE AS REPORTED BY
MOTHERS ON SIX ITEMS

| Score: | +6 | +5 | +4 | +3 | +2 | +1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Frequency: | 11 | 48 | 37 | 28 | 33 | 21 | 12 | 5 | 1 | 2 | 3 | 0 | 0 |

behave himself in school, must mind the teacher, must be quiet, must not interrupt, that the teacher takes the place of his mother and is the boss. In some cases, the teacher has been held over his head as a kind of veiled threat, "You'll have to change your ways when you start first grade." "You won't be able to get away with that stuff in the first grade." "Wait till the teacher sees you acting like that. You won't do it long." Most parents, however, try to present the teacher as a kind and benign socializing agent, "Be nice in school and everyone will be nice to you." "Like the teacher and she'll like you" is the gist of what some children are told.

To supply quantitative data on expectation-preparation for school a plus one was given for each answer indicating positive expectation-preparation, a zero for indefinite or indeterminate response, and a minus one for each answer indicating negative or no expectation-preparation. These were added together and expressed as a sum. Results are shown in Table I. Here we see that most of the parents are reporting positive expectation preparation, with a median score of +3.

Additional information on how dramatic an event first-grade entrance is to the young child came from parents' answers to the questions in the

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second interview. "Does your child feel that going to Grade I is more important than preschool? How does he show this?" Almost all of our parents answered in the affirmative. Their answers included such comments as, "He acts inflated now. Comes home and says 'Boy, we sure had some hard work today!'"; "Considers kindergarten children quite babyish. He acts big at home and is proud of his reading. He never showed pride before"; "She thinks going to first grade and learning her letters is the best thing that has ever happened to her"; "Feels she isn't playing any more. Feels important because she brings home so many papers." Out of 202 mothers answering this question, 81 per cent answered positively that the child gave indications of feeling more important, 11 per cent indicated no preschool experience and 8 per cent felt that there had been no change in the child's feeling about himself.

Reports on the child's going off to school the first day corroborated the other evidence that this is a big event and a happy one. Sixty-one per cent of our mothers reported the child went off happily. It is apparent that he is apprehensive; he is reported as not sleeping well the night before, or waking up at 5 a.m. and asking, "Is it time yet?" However, on the whole the reaction as reported by mothers was favorable. They also report that new clothes, the opportunity to walk with pals, or taking the child helped on this first day. Nineteen parents reported difficulty in getting the child off to school. Parents attribute this to unfavorable expectations of school built up in the child's mind by other children, or to immaturity.

What mothers tell us about their child's expectation of, and reaction to, first-grade entrance, then, would seem to substantiate our thesis that this is a very important event for six-year-olds, and one that seems to bring with it observable changes in the self-concept.

2. Difficulties in adjustment at six may be due to the fact that the socialization process is disturbed by the effects of first-grade entrance with its accompanying pressures for new adjustments.

The reader will remember that in the introduction to this paper this particular hypothesis was proposed to explain the kind of behavior Gesell and Ilg reported as typical of the six-year-old.

To see whether the kinds of behavior reported above came with entrance to first grade, four questions in Section 3 concerning changes in behavior were asked of the parents in the second interview, which took place ten or twelve weeks after school had begun. A fifth question had to do with possible changes in attitude toward the mother following school entrance. The five different items in this particular section will be discussed separately first.

a. Does the child act any differently now than before he started to school?

Of the 198 mothers answering this question, 86 per cent reported change in behavior and 14 per cent no change in the child. On the positive side they reported such changes as acting older, taking more responsibility, helping more at home, being less irritable, more self-controlled, having better work habits and the like. On the negative side, such behavior as acting smart-alecky, whining, increased aggressiveness with siblings, more irritability was reported. Of the 170 parents who reported change, 78 per cent mentioned ways in which the child was changing for the better; 22 per cent mentioned change for the worse.

b. Is he more independent? In what ways?

Here again our first-grader tended to get a clean bill of health from the mothers who were interviewed. Almost three-fourths responded positively to the question regarding increased independence. They reported more independence in dressing self, beginning work, entertaining friends, going on errands, shopping for groceries, staying alone at home, bathing, and helping around the house. While it is recognized that growth in independence might represent an unwelcome challenge to some mothers, the items reported by our mothers indicate growth in independence which they regarded as positive.

c. Does he resent being told what to do? Does he want to do things his own way? More so than before school?

d. Does he blow up more easily now than before he started to school?

Unfortunately, because we assumed the Gesell-Ilg description of sixness would fit our sample, these two questions were worded in such a way that parents reported either that there was no change in the child's tendency to be resentful or to blow up, or that he had changed for the worse. Had we also asked a question regarding change in a positive direction, our result might have indicated more positive change. As it was, with regard to whether the child resented directions more than at the pre-first-grade level, 60 per cent of our parents reported no change, 12 per cent that the child was less resentful and 27 per cent more resentful. In answer to the question about blowing up more easily, 57 per cent of our mothers indicated no change, 20 per cent that the child was improved in this respect, and 23 per cent that he was worse. In other words with regard to the difficult, explosive kind of behavior we had expected to find, most of our mothers reported either no change or change for the better.

Additional information with regard to items c and d came from comments offered by the mothers in responding to these two questions. Mothers who said the child was improved with respect to resenting being told what to do and with respect to blowing up indicated that he was more cooperative, easier to talk to, more reasonable in seeing another's viewpoint. Where

no change was reported, many mothers indicated by their remarks that this particular aspect of behavior was not considered a problem. Their comments, "He's always been that way, but I guess most of us don't want to be told what to do most of the time," "He's about the same as he's always been—I guess most kids have some temper when they're growing up," indicate a kind of philosophic acceptance on the part of some mothers of some negative response to direction. We also had mothers who reported no change, because they had never tolerated any such behavior on the part of the child. "I expect obedience from my child; if he doesn't like what I tell him to do and doesn't want to do it, I whip him until he does" was one mother's way of expressing her feeling in this respect. Where negative change was reported, some mothers blamed school pressures. "He has to sit and take it all day, so of course he blows up when he gets home." "It's having to be quiet so long in school—he's full of pent-up energy and explodes at the least little thing around the house" were some of the expressions of this feeling.

c. Does he ever imply that teacher knows more than mother? Hold teacher up as higher authority? Act as if parent doesn't know much? Is condescending in relating school events? Becomes impatient if mother doesn't understand? More so than in preschool years?

These questions were an attempt to get at possible changes in the child's attitude toward his mother as the result of a new socializer in the form of the teacher. We were interested in any evidence parents could give us to support or disprove our hunch that this new socializer would have the effect of weakening the omnipotent position the mother has had, and that this might show up in the child's comparisons of mother with teacher. Fifty-eight per cent of our mothers reported no change in the child's behavior, and 42 per cent indicated change. Explanatory remarks by parents gave us additional information. In general, their remarks might be grouped as follows:

1. Remarks indicating no change in attitude toward parent.
2. Remarks indicating no change observed by parent with explanations of why there was no change: "I always taught him obedience so none of these questions apply. I taught him respect for his parents."
3. Remarks indicating the reverse—parent held up as higher authority than the teacher: "She always holds *me* up to the teacher. I tell her, 'Well, honey, you have to do it the way the teacher tells you—She's the boss there.'"
4. Remarks indicating a change in attitude toward the parent in the direction of lessened omnipotence: "He definitely implies that the teacher is a higher authority from the way he does his schoolwork

to the way he puts his coat on." "He thinks the teacher is perfect and that I don't know anything; he corrects me all the time and refers to how perfect the teacher is." "She condescends toward me and is definitely and markedly more impatient when I don't understand."

5. Remarks indicating a change in attitude toward the parent in the direction of lessened omnipotence, with the parent expressing an ambivalent attitude toward it: "Yes, she always aligns herself with the school and teacher, especially when we're having arguments." The interviewer continues with the comment, "The mother seems to admire this trait in her daughter, but this does not prevent the mother from 'doing battle,' so to speak, and letting Lucy know how she (the mother) feels about it. This mother is a 'griper.' She spent about ten minutes telling me of the battles she had had with the teacher, the school nurse, etc., etc. She blows off steam in front of Lucy, and lets her know exactly how she feels."

It seemed to us that these different categories of remarks raise some very interesting questions regarding implications of the differences we found. For some children, it would seem that dependency relations with the mother are so strong that the school does not change them; that for others there is a marked difference, and that the attitude of the mother toward change in the child is a factor to be considered. Reasons for these differences obviously lie in preschool socializing experiences which need further exploration.

In summary, then, on the question of what mothers report regarding their child's behavior, for the particular items in our questionnaire we found most mothers reporting change in the child's behavior, with most mothers noting improvement in some areas and no change or improvement in areas dealing with the child's explosiveness and reaction to authority. No change was also reported by more mothers on the question of teacher-mother status in the child's eyes, but here the difference between no change and change was not so great.

In addition to information concerning mothers' observation of changes in child behavior since first-grade entrance, we also asked questions about the child's liking or dislike for school, since conceivably there might be a relationship between this factor and child behavior. We asked the direct question, "Is the child liking school? his teacher?" but also asked, "Does he ever say anything critical about school? About his teacher?" and, "Has he ever said he didn't want to go back to school? Hesitated to leave in the morning?"

To the first question regarding liking for school and teacher, 92 per cent of the mothers answered in the affirmative, with only 8 per cent being

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neutral or negative. Many of the answers indicated a high degree of enthusiasm. "Crazy about it—wants to go Saturdays and Sundays." "Cries when he can't go because of a cold." "Loves his teacher—thinks she's a wonderful person" were some of the replies. However, although over-all liking for school was high, 42 per cent of the mothers mentioned criticisms of the school made by the child, and 39 per cent reported there had been days when the child did not want to return to school. Criticisms of the school by the child included criticism of the actions of other children (too noisy, too rough, too naughty), of school rules and regulations (lining up to go to the bathroom, keeping quiet, punishing whole class for one child's naughtiness), of school program (too much work, too much coloring, too little play), of the substitute teacher. To a related question concerning difficulties with other children, 137 mothers reported trouble. Two kinds of difficulties were frequently mentioned, the first of which involved aggressiveness on the part of other children ("Older boys pick on him," "Older girls pick on her," "One child shoves him around"). There were 79 of these complaints where other children were the aggressors. Some mothers reported their own children as being at fault. The other kind of difficulty most frequently mentioned involved situations where a child was excluded from a group ("She cried because they wouldn't let her play with them," "The other girls don't let her jump rope").

SUMMARY AND DISCUSSION

An exploratory study of the possible effects of beginning first grade upon socialization was conducted by means of interviews with mothers. Two interviews were completed with 212 mothers, one prior to first grade entrance, and one after two months of school. Results indicate:

1. In general, children look forward to beginning first grade with a high degree of favorable anticipation. According to what mothers tell us, they look upon the experience as a very important stage in the process of growing up. They have picked up a considerable body of information and misinformation regarding first grade activities and are expecting to work, and to learn certain specific skills in school. The school has also been presented to them as a socializing agency and one which will expect certain standards of conduct from them.

2. In general, beginning first-graders show evidences of change in self-concept in the direction of feelings of bigness and importance, according to what mothers tell us. This was true even for children who had attended nursery school or kindergarten. Preschool apparently does not represent as dramatic a shift away from home, nor does it have the prestige value for children that first grade does.

3. In general, children's behavior improves with respect to such traits as responsibility, helpfulness, good humor, independence and the like following school entrance, according to what mothers tell us. With regard to response to directions and to self-control, either no change or change for the better was reported by most mothers.

4. With regard to attitude toward the mother's authority and importance as compared with the teacher's, most mothers report no change following school entrance. However, a sizable minority report no change in status of the mother.

5. In general, first-grade children like school very much. Their greatest task of adjustment is in the area of social relationships. They find it hard to take the aggressiveness of other children, especially when directed against themselves, and to understand the behavior of children when it differs from their standards of goodness and badness.

Our results have led us to abandon the notion that sixes are "out-of-focus." Indeed, the theory that children are inevitably in-or-out-of-focus at a particular age would not jibe with our results. Rather it would seem that if sixes or any other age group show improvement or deterioration we had better look, not to innate causes, but to experiences which they are having in common. Differences between our findings with respect to six-year-old behavior, and those of Gesell and Ilg are no doubt attributable to the difference in the sample.

On the whole, the experience of entering first grade would seem to have favorable effects upon behavior. It would also seem that the experience of beginning school is a highly important one for the six-year-old, and an ego-bolstering one. Whether this is a temporary state of affairs and whether disillusionment will set in later on during the first year in school remains to be seen. We also need to investigate further the hypothesis that ego-enhancement at six and improved behavior are connected. While our data indicate that these two phenomena exist in the parent's mind, it may be that parents think behavior has improved, whereas, actually, because the children are away for a larger part of the day, there are fewer opportunities for behavior difficulties to occur. Further work with children to find out the meaning of this experience for them is necessary.

But we also need to remember that there were different patterns of adjustment reported by mothers following school entrance. Some mothers whose children had been "problem" children before school reported tremendous improvement, but some "problem" children did not improve. One of the next steps in our project will be a study of these varying patterns of adjustment after school entrance with particular reference to earlier socializing experiences.

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APPENDIX A

INTERVIEW SCHEDULE FOR PARENTS OF SIX-YEAR-OLDS

Child's name Address

Father's Name Telephone

Father's occupation Birthdate of child

Place of birth of father Place of birth of mother

Siblings (names and ages):

 Previous school experience of the child

1. Is he looking forward to school? What does he think about it?
 - a. What have his parents told him about school?
 - b. What have his older brothers and sisters, if any?
 - c. What have other children?
 - d. What does he expect to do in school?
 - e. What kind of person does he expect the teacher to be?
2. What has he been taught before going to school? (check appropriate responses)
 - a. alphabet.... nursery rhymes.... write his name.... reading....
 numbers.... others

 - b. about behaving in school?
 - toward the teacher
 - toward other children
3. How much has he been on his own before school?
 - a. crossing streets?.... Which ones?
 - b. Did he go back and forth to pre-school by himself?
 - c. Does he go to the store by himself?

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- d. church or Bible school?
- e. movies, park?
- 4. What opportunities has he had to play with other children?
 - a. How does he get along with them?
- 5. How does he get along at home? Any special problems?
 - a. Is he pretty noisy and full of pep?
 - b. Does he ever answer back or "sass"?
- 6. Has he had good health this past year?
- a. Any contagious diseases, mumps, measles, etc.
 - b. How many colds?
 - c. Does he often have stomach aches?
- 7. What responsibilities for himself and the house does he have?
 - a. Care of siblings
 - b. Dishes, beds or other housework
 - c. Care of room
 - d. Care of clothing
- 8. How did the mother like school as a child?
The father?
 - a. How far did the mother go in school?
 - b. How far did the father go?
 - c. How far do they expect the child to go?
- 9. What would the parents like for the child to get out of school during this first year?
- 10. What would the parents like the child to be when he grows up?

APPENDIX B

Child's Name

I believe in the last interview you mentioned that
had attended preschool. Why did you send him? (Or if he didn't go, why
didn't you send him?)

1. Is the child liking school? his teacher?

What does he say about school?

Do his comments differ from comments on preschool?

Is it hard (or harder) to get information out of him (than during his preschool)?

Does he ever say anything critical about school? About his teacher?

What? (Exact words, if possible)

What does the parent say when child asks questions or criticizes the school? (Tell child school is right, or perhaps say school is wrong.)

Does he feel that going to Grade I is more important than preschool?
How does he show this?

Does the school insist upon some rules and regulations you can't see any sense in yourself? What? What do you say about them to the child?

2. Did the child have any problems of adjustment to school? How did he feel about going off the first day?

What helped to make the first day easier? Did he go with a pal?
New clothes? Pals in the room?

Has he ever said he didn't want to go back to school? Hesitated to leave in the morning?

Did he ever report crying at school? (Describe incident)

Has he mentioned difficulties with other children?
(Fighting, picking on him, refusing to let him play)

Has he missed any days because of illness? How many and for what?
Complained of stomach aches?

Has there been any occurrence of nervous symptoms such as thumb sucking, nailbiting, bedwetting, temper tantrums?

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3. Does the child act any differently now than before he started to school?
In what way?

Is he more independent? In what ways?

Does he resent being told what to do? Does he want to do things his own way? More so than before school?

Does he blow up more easily now than before he started to school?

Does he ever imply that the teacher knows more than the mother? Hold teacher up as a higher authority? Act as if parent doesn't know much? Is condescending in relating school events? Become impatient if mother doesn't understand? More so than in preschool?

4. Did the child receive his report card yet? Was it a pretty good report? What did you say to him about it when you saw the report?



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